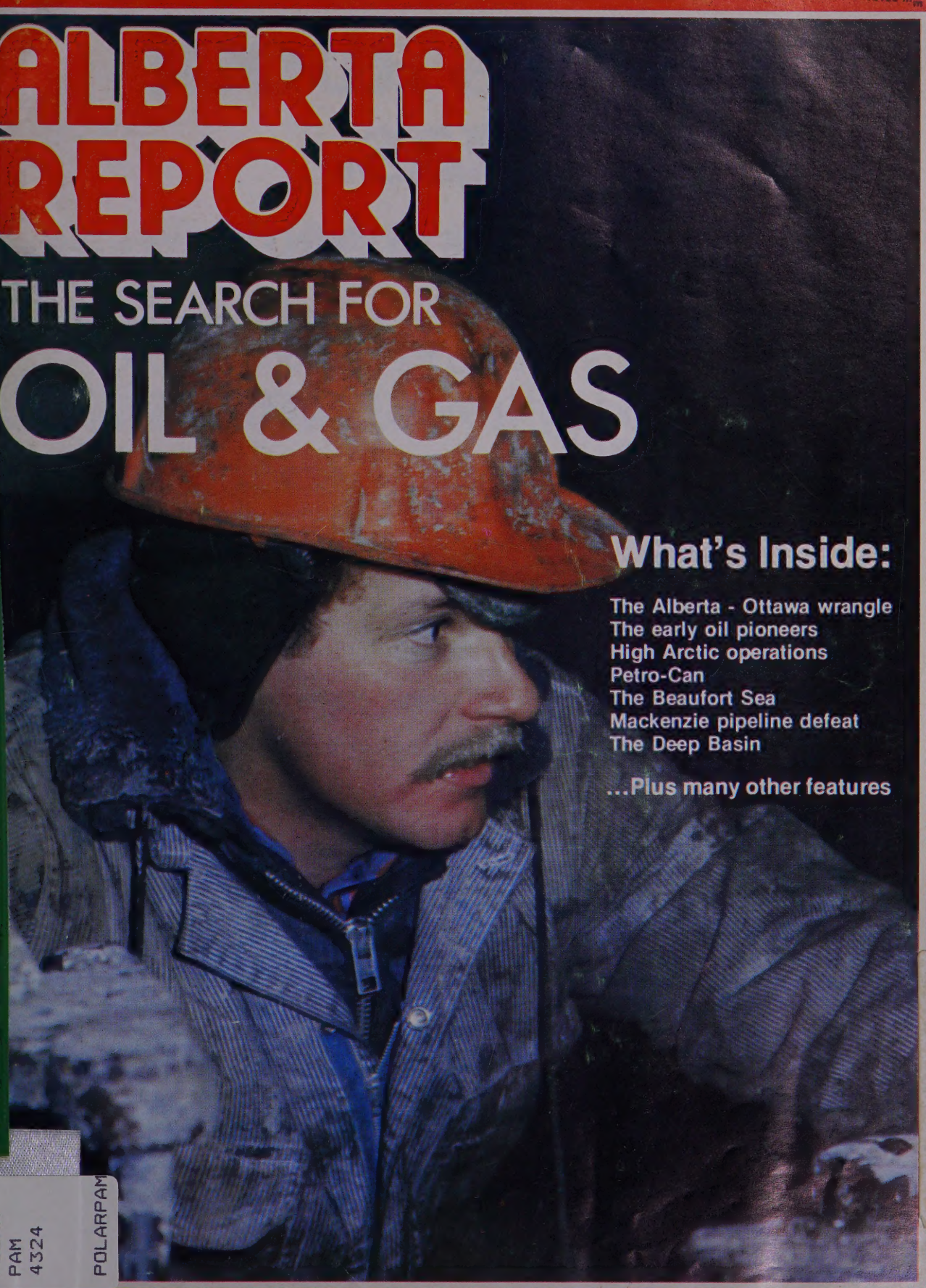
ALBERTA REPORT

THE SEARCH FOR OIL & GAS



What's Inside:

The Alberta - Ottawa wrangle
The early oil pioneers
High Arctic operations
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The Beaufort Sea
Mackenzie pipeline defeat
The Deep Basin

...Plus many other features

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Q: "Why is price important and how does what we pay compare to the rest of the world?"

Q: "Who controls Canada's oil and natural gas industry?"

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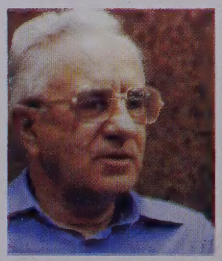

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The Petroleum Society of CIM, a division of the Canadian Institute of Mining and Metallurgy, provides an exchange of technological information among those involved in the exploration, production and transportation of oil and gas, and encourages interest and promotes understanding of the petroleum industry. This effort is highlighted by an annual spring Technical meeting for members, regular publication of "The Journal of Canadian Petroleum Technology," and regular programs of interest to its 1441 members in three Sections located in Ottawa, Edmonton and Calgary.

To foster understanding of, and encourage interest in Petroleum industry career opportunities, the Petroleum Society has initiated a number of programs which readers are encouraged to pursue.

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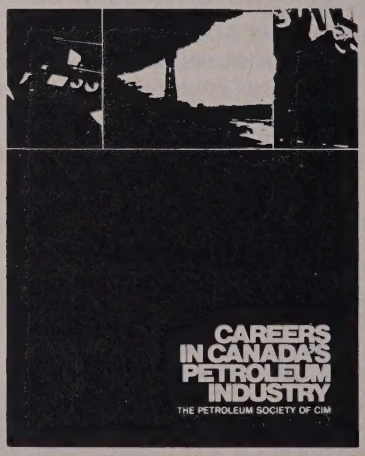

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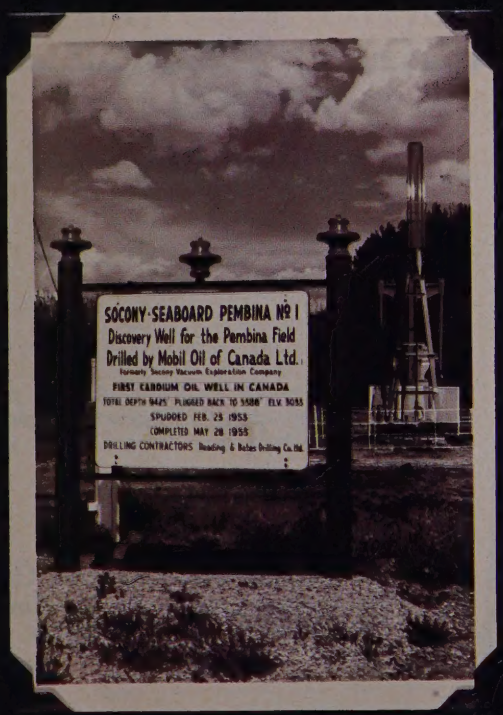
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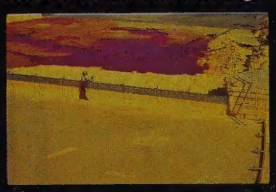

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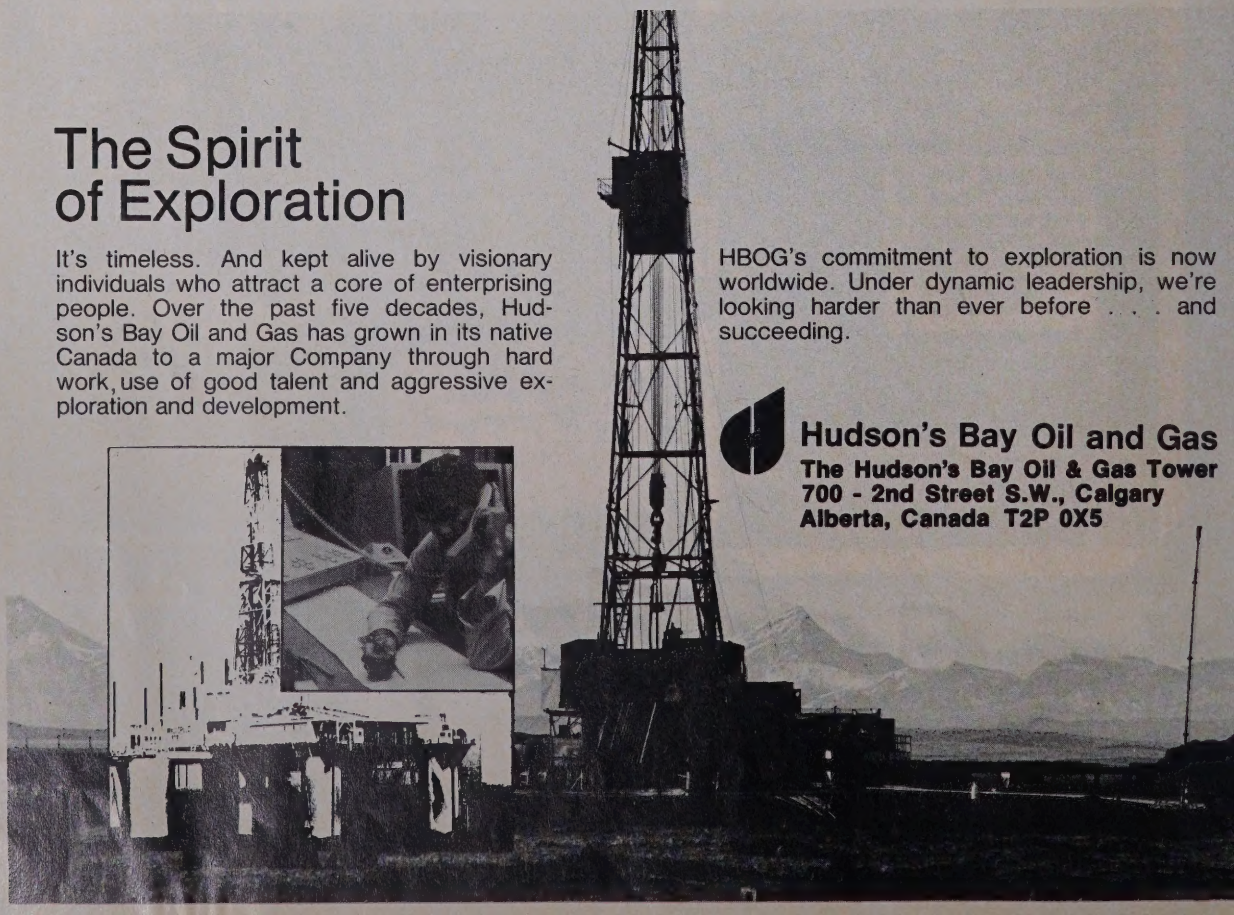

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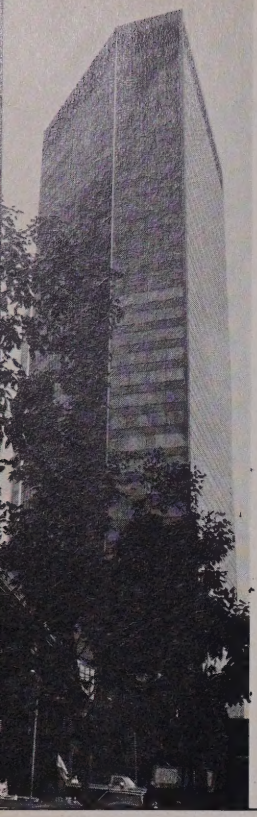

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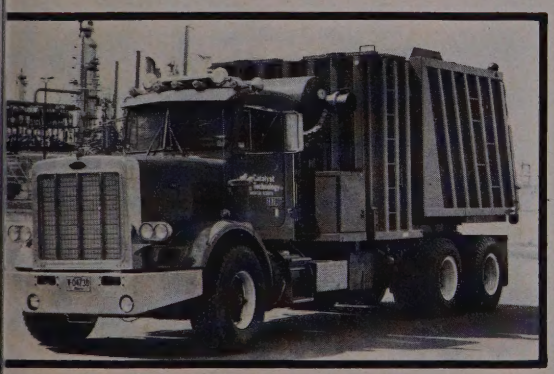

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LYNES

HISTORY

Alberta vs. Ottawa

The battle for petrobillions

To the federal Liberals reigning in Ottawa it seemed a matter of little significance. One band of Alberta right wingers, the Conservatives under someone named Peter Lougheed, had shattered the 36 year rule of the equally conservative Social Credit Party. A couple of months later an emissary duly arrived from the new government of this thinly populated province 2,000 miles from the Canadian capital. Again no one paid much attention. Naturally, out of simple courtesy, cabinet ministers carved a few minutes from their busy schedules to exchange a few pleasantries with the fellow. But of course there really wasn't too much to say and the man's departure was no more noted than his arrival.

The visitor's name was Donald Ross Getty and, at age 38, he had been named to a post created by the new administration, the ministry of federal and intergovernmental affairs. By trade an oilman, he had the youthful, square-cut good looks associated with hair grooming commercials. Through his eyes the little visit to Ottawa appeared a lot less trivial than it did to his federal hosts.

"What struck me very forcibly was their attitude. Everyone I saw had an air of half smiling condescension and basic indifference. I was there as a delegate of the Canadian government to try to establish the sort of personal relations we believed would facilitate future cooperation. But the message I was given very clearly was that there was no time for that. My mission wasn't sufficiently important." Today Don Getty notes wryly matters stand a little differently.

If anyone intimately understands the change, it is he. For seven years he was field leader for the Alberta negotiating team that hammered through the most vigorous clash that has ever occurred between a Canadian province and the federal government. At one point the country's minister of energy stood in Parliament to label Don Getty as a man "dripping with venom." The Alberta minister's particular sin on that occasion had been to suggest that the Trudeau regime call an election on provincial rights.

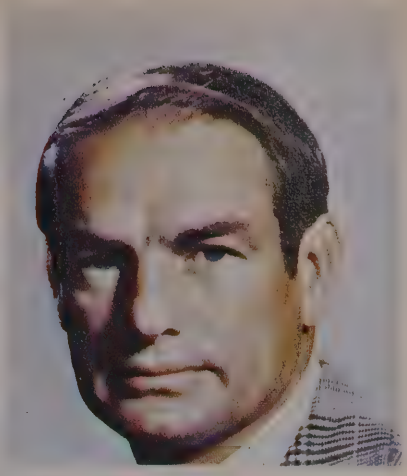
Alberta's concern for provincial rights was born in 1905 with the province. When the federal government sliced Saskatchewan and Alberta out of the Northwest Territories, the two new provinces were not given control of their own natural resources. Under the British North America Act, Canada's founding document, natural resources are within the jurisdiction of provinces. But the federal government argued that, since in territories resources are in their domain, Alberta and Saskatchewan were not the same as other provinces. After considerable political wrestling, Ottawa handed these rights over to these two western prairie provinces in 1930.

At that time Canada's oil and gas production did not figure as a major prize. First, there wasn't much of it and second, energy prices around the world were low. Over the next few decades a seemingly endless river of cheap oil was being transported to North America's population centres from Mexico, Venezuela, and the Middle East. By the end of the Fifties much of the world's industries were dependent on these supplies.

Would Alberta oil profits flow Eastward or foster growth in the West?

That year an event occurred that would have profound effects on the balance of economic power within Canada. The world's largest oil selling nations grouped themselves into the Organization of Petroleum Exporting Countries (OPEC). But the effect of the fledgling group would not be felt for a decade. Meanwhile the stream of cheap energy flowed on.

In the year OPEC formed, 1959, a major controversy erupted in Canada between western producers and a coalition of eastern governments and consumers. The arena was the hearings of a royal commission appointed by the federal government to map out overall national energy policies. Chaired by Henry Borden, president of one of central Canada's largest corporations



Donald Ross Getty
Voice in a storm

(Brascan) and a former senior Ottawa civil servant, the Borden Commission did the producers few favors. Depositions from Ontario and Quebec noted that western petroleum would cost them two cents more per gallon at the service station pump than foreign supplies.

Canada's richest province, Ontario had waxed wealthy in part because western consumers paid higher than world prices for the province's tariff-protected manufactures. Now in partial repayment Ontario declared itself willing to pay the premium for western oil. Quebec insisted it would take no western oil and the Maritimes, a small market, concurred. Alberta producers submitted that if the major Montreal market was available, larger pipelines would be economic and could carry their product to Quebec at an internationally competitive price.

This plea was urgent because the western independents badly needed another market besides Ontario to get their production high enough to achieve efficiency. A well producing below a certain fraction of its potential cannot return investment rapidly enough to justify its original cost. A pipeline gathering and transport system carrying only a portion of its potential may not be able to function financially. Quebec declared itself uninterested in these theories and opted for imported oil. The Borden Commission recommended that western oil stop at the Ottawa River and the government agreed. Western warnings that overseas supplies might not prove entirely reliable were ignored.

There is a proverb in the oil patch: energy left in the ground tends to accummulate in value. So it proved in this case. Midwest American states bought enough western crude to rescue the Canadian industry. The portion unconsumed by Quebec turned out to be

something closer to the world rate, over a dollar. In the spring of 1974 a federal-provincial energy conference involving all eleven Canadian governments was called. The Alberta energy team attended in a very pugnacious frame of mind. At the meeting it was agreed there would be a single price for oil across the nation. The initial $6.50 a barrel fee would be stepped up towards the international price at a dollar a year. But the world price was actually moving up faster than that.

Mr. Getty recalls, "We went in determined to fight so hard on the oil export tax that the federal government would hesitate before trying the same trick with gas. They haven't. We were determined to struggle almost to the point of secession for our right to set the price of our oil." Alberta shortly after created the Alberta Petroleum Marketing Board, a Crown corporation formed by the province to buy and market all oil produced here. This agency is empowered to set prices.

But the principle that provinces can price their own resources has not been conceded by the federal government yet. In the 1979 election Prime Minister Trudeau remarked publicly that the price of oil was too important to be set by the province of Alberta. That was followed by a further implied threat: that he hoped he would never have to invoke the War Measures Act to force the distribution of energy to the nation.

After the 1974 conference, which agreed the federal government would get no part of the $6.50 a barrel price, the Lougheed administration set a new royalty rate that left the private sector of the industry "frigid with fury," recalls Mr. Getty. "I now believe we went too far when we upped the royalty rate from 22% to about 65%." Companies began slowing their exploration activities significantly, preparing to move new programs into the U.S. and elsewhere.

But former minister Getty, now a consultant in the energy industry, recalls the pressures to raise royalties dramatically. "There was talk among the federal government of imposing more export tax themselves so industry wouldn't get so much benefit from the hike to $6.50. Within a year we ourselves would be in an election and we didn't want to look like stooges to the feds and industry, letting them take huge profits. If we didn't do something some of the companies might just take the quick gains and not reinvest them. And of course those big profits would be income taxed by the federal government."

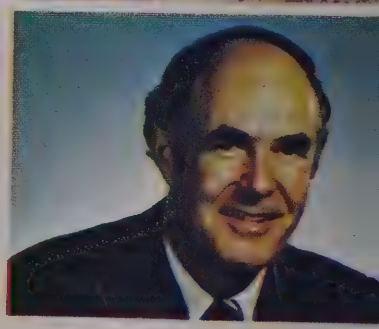
The Trudeau regime decided the new Alberta royalties were an unreasonable pillaging of their treasury and promptly announced that royalties paid to provincial governments would no longer be tax deductible. In other words a company would pay federal taxes on the money it was forced to give to the provincial government. In Saskatchewan and British Columbia the provincial bite went even deeper. Exploration activities decreased so dramatically that all governments were forced to rethink.

Around the Alberta legislature, the pressure grew intense. As the drilling rigs headed south, energy industrialists bombarded the cabinet ministers with threats and entreaties to reach a settlement with Ottawa. The media communicated industry's deepening worries to the public. In Calgary, separatist schemes were being openly discussed by a small but potentially influential minority. The more nervous members of the ruling political party and the civil service wondered if Alberta's position was reasonable.

One observation buoyed the Lougheed inner team. Recalls Mr. Getty, himself born and educated in eastern Canada, "The people of Alberta stuck with us superbly. We knew they knew who was being reasonable and who was not. This province's greatest strength is its ability to unite in the face of attack." Nevertheless he vividly remembers the relief he felt when he escaped on a short fishing trip with two of his four sons.

Secretly, tough negotiations were underway with the federal government to resolve the impasse in which everyone was losing. No one liked seeing exploration activity plummeting just when new domestic supplies were so anxiously awaited. Eventually, says Mr. Getty, the two sides literally shook hands on a revenue-splitting arrangement. Happy the mission he'd headed had apparently succeeded, Alberta's intergovernmental affairs minister arrived back in Edmonton.

Within days the federal government reneged on the agreement. "They said we were naive to have believed they'd really accept that bargain, no matter what had been promised at the time," Mr. Getty believes Alberta's subsequent publicly-announced severing of relations with Ottawa was the first such move by one Canadian government towards another. The deep freeze lasted about a year. Then Alberta announced it wanted offers to help refinance the Syncrude oil sands mining project after a major private sector partner pulled out. From Ottawa came the enquiry if the invitation included them. They were told it could, if they were prepared to abide by their word. From then on Alberta insisted on written agreements.



TOP TO BOTTOM, PRIME MINISTER PIERRE TRUDEAU AND FEDERAL MINISTERS DONALD MACDONALD AND ALASTAIR GILLESPIE
Practitioners of "strong" leadership

But by then both sides had retreat from their oil revenue positions. To low the private sector enough profit coax it back to active life, Alberta ma several concessions. They refunded th 11% share of the federally-collect corporate tax to the oil companies. N wells could produce for five years roy ty-free and all drilling costs earned company partial relief from royalties. found before the OPEC price hikes w to stay at the 65% revenue rate but ne oil would be let off much more light

d on all increases on the barrel price er $6.50, the royalty rate dropped to %. For their part, the federal governnt once more allowed a portion of the ovincial royalties to be deducted from xes.

It worked and by the winter of 1975 ploration was picking up rapidly. Mr. tty considers that new federal energy licies "bear a striking resemance to those advocated by our governnt." Federal hopes for exploration on e Arctic Islands and offshore Newndland, lands they control, failed to d massive discoveries quickly. So they rned to what Alberta had been insistg all along was one route that had to be apped out as soon as possible — the tar d oil sands. When in August of 1978 arrelling threatened to flare up again, was resolved without paralysing the dustry. Mr. Getty, then holding the ergy minister portfolio, comments at behind closed doors, the bargaining ce more got hard-nosed.

"They announced, again unilaterally, at the next dollar a barrel increase ould be postponed. But now we had a gned contract. No province supported e idea that the federal government uld renege on a written promise to other Canadian government." After ore tough talk, Mr. Getty and his lleagues patched together a compro-ise with their counterparts in Ottawa. The dollar increase would be postponed six months but another two dollars would be added over a further year. The Alberta government has repeatedly stated that it has no wish to harm Canadian industry's international competitive position and will always sell to any Canadian at a "fair" price.

Though it may come as a surprise to many outside the province, Albertans tend to be proud of their province's consistent generosity throughout the entire fracas. So far the revenue difference between the Alberta and world prices of oil and gas has amounted to over 14 billion dollars. Thus Alberta has given up a gigantic sum of revenue, a donation without precedent-in Canadian history. The present $14 a barrel is at least $6 below what Alberta oil would fetch in other countries.

The Heritage Trust Fund, a pool of capital saved by the Alberta government from its oil revenues, is not intended to finance luxurious living for a wealthy citizenry. Before oil and OPEC together began altering the nature of the Canadian economy, westerners had a fairly stable population that made its primary living off renewable resources such as farming and forestry. Mining, though significant, was on a scale that allowed depleted deposits to be largely replaced by new finds. But now Alberta in particular has a mushrooming population based on a disappearing resource, oil and gas.

The Lougheed government is far from panicking over the people influx. But one day when the oil is largely gone or someone has worked out alternate energy sources cheaper than Alberta's expensive tar sands and tight gas, hundreds of thousands of people may well need another way to make a living. Westerners recall the century long economic depression that has enveloped the once prosperous Maritimes since the change from wood ships to steel ruined the region's primary industry. Should the energy business of the West be struck a blow even fractionally as severe, the agricultural base would almost certainly be incapable of taking up the slack.

Therefore Alberta's government is determined to encourage any manufacturing that can profitably be located here. It's a stiff challenge. The region is far from the world's major populations, markets and cheap water transport. The purpose of the Heritage Trust Fund is to lubricate this economic transformation, fostering research and new development. For whether the people affected approve or not, the world's oil revolution has committed the Canadian West to the path of growth, industrialization and socio-economic maturity.

THE HYDROCARBON MYSTERY

eople have valued, even worshipped, oil and gas for thousands of years but how it orms is still unknown.

Oil is the most plentiful liquid in the world after water. It is found from e iron Arctic permafrost to the burng sand of the Sahara, from New uinea's jungles to the farmlands of olland. Still, modern industries gulp it own in such prodigious quantities that ding sufficient long term supplies is ow threatening to become a critical oblem. Adjusting modern civilization cope with severe shortages would be r from simple. This single raw material els most of the world's transportation id provides well over 3,000 petroemical products, from clothing to ousing. World consumption is spiralling er higher.

Canada possesses 2% of the entire own reserve of conventional liquid etroleum. As well this country contains assive supplies of other hydrocarbon nergy sources. Significant amounts of atural gas plus uncalculated but vast eposits of coal are supplemented by the orld's largest single accumulation of etroleum — the oil sands of northern lberta. Though the greater part of these resources remain too expensive to process into useful forms, the rising world price and developing technology is already changing that picture.

Eastern Canada is oil poor. Ontario's small oil reserves have been largely exhausted. Off the coast of Nova Scotia there have been recent hydrocarbon discoveries potentially significant to the Maritime region but likely not large enough to affect the nation as a whole. In the Arctic islands significant finds of natural gas have been made along with small amounts of oil. Off the Labrador coast preliminary drilling has reached encouraging but as yet inconclusive traces of hydrocarbon. Overwhelmingly Canada's reserves of oil and gas lie west and northwestward.

The hand of fate that has given the West these immense sources of power began its work more than 500 million years ago. For much of the time since then the prairies were covered with outstretching arms of the Pacific, the Arctic Ocean and the Gulf of Mexico. As these waters advanced and receded, they left behind them layers of silt. Covering bedrock that geologists believe is at least four billion years old (the estimated minimum age of the planet) these layers of sediment contained the remains of countless trillions of tiny plants and animals. At the time the climate became warm, fostering lush, heavy growth.

Oil formed in these sedimentary layers. The currently favored theory is that pressure, heat, time, bacteria and radioactivity transformed these plant and animal remains trapped within the sediments into both liquid and gaseous hydrocarbons. Petroleum, another term for unrefined crude oil, stems originally from two Latin words, petra and oleum, meaning rock and oil. Precisely how petroleum formed remains a puzzle not yet completely pieced together.

Though experts do refer to pools of oil, petroleum and gas are virtually never found underground in any form resembling a pool of water. Instead billions of drops are held between the crystals or grains of sand in the pore spaces of the

Early drilling outfits in southern Ontario
Canadians drilled the world's first successful well specifically aimed at oil.

rock. One of the remaining mysteries is why oil is rarely plentiful in the type of rock where the cemented solid remains of these ancient plants and animals are found. Known as source rocks, these tissue trapping source sediments include shales and some limestones. Reservoir rocks, where oil often is found, are usually more porous forms of sandstone and limestone.

One theory is that the oil was squeezed out of the source rocks where it formed. Bolstering this theory is the observation that the shales and limestones that make up most source rocks are fine grained, with very little space between the grains. The pressure that squeezed these rocks so tight left no room for the droplets of oil and gas, which were forced to move into the more porous reservoir rocks.

To be useful to man reservoir rock must be more than porous, it must be permeable. Permeable in this case means the spaces between the crystals and grains are connected enough to allow the resource to flow through the rock towards a well bore. Professionals refer to porosity and permeability as the P & P factor.

Oil, gas and water all rise within the ground as persistently as a stick bobs to the surface of a lake. If oil can get close enough to open air, its liquid and gaseous components will evaporate, leaving behind a sticky, black residue called tar or bitumen. This is the origin of Alberta's vast tar sands. Bitumen deposits further underground, also common in Alberta, are termed oil sands. Estimates of the amount of pure oil locked in Alberta's bitumen reserves range upwards of a billion barrels, a hundred year supply for Canada at the present rate of consumption.

But the gummy substance must first be separated from the sand in which it sits, then go through complex upgrading processes. Another Canadian petroleum resource that must be upgraded are the heavy oil deposits in the Lloydminster area of Alberta and Saskatchewan. This oil, though more liquid than bitumen, is far thicker than conventional crude. Special recovery techniques using heat and steam must be applied to make the sludge flow to a well bore.

But much oil never got near enough the surface to thus lose its liquidity. These lighter crudes are still what sates the international demand for petroleum. Oil-hunting geologists look for more than source and reservoir rocks. They seek geological formations known as traps that could have stopped and collected oil and gas migrating towards the surface. Though even the existence of source and reservoir rocks in good trap positions does not guarantee oil and gas will be found, where all three conditions exist oil companies are willing to spend the millions of dollars necessary to find out. In the end only actual drilling can prove the existence of oil and gas in comm cial quantities.

Oil rises within the ground beca the pressure of the earth forces it al the line of least resistance — towa the relatively pressure free surface. effect is similar to wrapping a fist aro a wet sponge, leaving exposed only part of the sponge's surface. W squeezed the water will travel to exposed area much as oil and gas s through the ground towards air. Th are a variety of geological traps that stop this migration and thus collec worthwhile pool.

The simplest is a layer of impermea rock such as shale. Often though resources will be able to travel sidew till it finds a way out of the trap. formation that early petroleum ge gists found stopped this lateral mo ment resembles an upside down bowl layer of impermeable rock bulges ward. Once inside the bowl the oil or is trapped by its own upward pressu When the Rockies thrust up 50 mill years ago, the movement buckled flat sedimentary layers formed earl This buckling formed a bowl-type trap the Turner Valley area southwest Calgary.

In Alberta sandstone formations c taining gas and oil are the remnants old beaches and river channels form along the coasts of ancient oceans. Elmworth field near Grande Prairie is example. The other common reserv rocks in the province are limesto evolved from reefs that developed off shores of even earlier seas. These re were formed by living organisms sim to those now building up the Gr Barrier Reef along Australia's nor eastern shores.

Petroleum varies from lemon yell through shades of green and bro to black. Man first recovered it fr bitumen pits occurring on the surfa The Old Testament records Noah's A was sealed with this "pitch." Asph boiled from raw bitumen was used mortar by the bricklayers who b Solomon's temple and many mass fortifications of the ancient river civ zations of Asia Minor. The Egypti waterproofed their pyramids and balmed their dead with asphalt fr "slime pits" near the Dead Sea.

The Oracle of Delphi, the voice o goddess consulted by the anci Greeks, was worshipped in a tem whose altar was graced by an "eter flame. The fuel was almost certai natural gas seeping from a deep r fissure. Persians of the Zorastrian r gion, a fire god cult, revered sim flames along the shores of the Casp Sea. Priests piped the colorless, odor gas from natural rock seeps to th

ters in one of the world's first natural as pipelines.

Warriors eventually got into the act. he Greeks, according to their most mous historian Herodutus, once de- ated an enemy fleet by flooding the sea ith oil and setting it alight. Likely they ere using a form of naphtha, a highly olatile liquid lighter than crude oil but eavier than natural gas. Later this hip-firing tactic became an important ol used by Europeans defending their omelands from Muslim fleets intent on preading the gospel of Mohammed rough force.

Across the ocean, pre-European civili- ations used tars and oils to make glue for nosaics, paints and medicines. An early European arrival wrote of a "spring or fountain of pitch." The first president of the United States believed the value of a piece of his land was enhanced by a "bituminous spring" occurring there. Though all the ancient uses of petroleum remain popular today, many of these purposes were actually temporarily forgotten at times.

The modern machine age begun in the nineteenth century created an enormous demand for lighting and lubricants. At first the primary source of oil was the whale. Under the severest conditions of weather and personal danger, men roamed from the Arctic to the Antarctic in wood sailing vessels slaughtering huge herds of these water mammals. The precious fluid was squeezed from the oil-rich blubber, meat, and even bones. But eventually the populations of these huge creatures began falling. (Today some species are nearing extinction.) Besides their oil, like other fluids derived from vegetables, fish and animal fats, made poor lubricant and smoky, smelly lighting fuel.

A Canadian made a major advance at this point. Dr. Abraham Gesner practiced medicine in Nova Scotia. An amateur chemist and geologist, he came up with a means of deriving kerosene from coal. It appeared that the patents Dr. Abraham Gestner held on the instantly popular lighting fuel would make him rich. By 1860 he estimated 70 plants were producing kerosene in North America. But in a few short years a cheaper source of kerosene had been found — rock oil. The threshold of the modern petroleum era had been reached.

Oil Dawn:

From Turner Valley to the tar sands, from poverty-struck promoters to international entrepreneurs, the western oilmen's sometimes bitter struggle has enriched a nation.

The year was 1947. The energy seekers of Alberta faced the bleakest rospect ever in the 30 year history of heir still small and struggling industry. Vith the relatively small exceptions of urner Valley near Calgary and Norman Vells in the far north, the western anadian sedimentary basin's tantaliz- ng geological formations had yet to yield commercial oil find. Eastern Canada gnored the oilmen's pleas for capital and he West itself had little cash to contri- ute to the seemingly endless search. he petroleum drought lasted longer han the misery and dust of western griculture's Dirty Thirties.

Even strong optimists had given up, he bulk at least half-convinced that the rairies and foothills of the West were a opeless hunting ground. Few Canadian ompanies remained active. Most had allen idle a decade or more before, ash-starved. The Yanks too were ready o call it quits. By 1947 the industry eader, U.S.-owned Imperial Oil, had rilled 133 holes in a row without making significant oil discovery. The company ad spent over $20 million in this series, vast sum for those times. All they had ound in Alberta and Saskatchewan ere some natural gas fields.

Others too had found gas. At that time here was very little local market for this as and no pipeline to take it elsewhere. Between the cost of piping and the elatively inexpensive competitive sup- lies available elsewhere, even the pros- ects for this natural gas were not right.

Imperial decided to build a facility to process natural gas into a liquid fuel for internal combustion engines. Though relatively awkward and expensive, the project was made economically viable by the distance from alternative sources of normal gasoline in the U.S. Turner Valley Oil, found a decade earlier near Calgary, alone could not supply the prairie market. Imperial planned to put the plant up at Edmonton, in the farmlands of central Alberta. Casting about for a site, their executives' eyes fell on Leduc. This little town 18 miles south of the Alberta capital was far enough from the city to avoid fume problems, near enough for convenience.

But another factor influenced the choice. Imperial geologists had high hopes that more natural gas lay nearby, a potential supply for the new plant. A well had been spudded late in 1946 to explore the limestone reefs believed to lie under the bleak snowdrifted surface. Early in 1947 the unbelievable happened. The probing drill bit chewing into the limestone released a bountiful gush of oil. Against all expectations and at the end of hope, the wearying search had succeeded.

Not only did the Leduc field contain a significant treasure of petroleum but other finds rapidly followed. Leduc was far from being the birth of the Canadian oil industry but it was the hard-pressed oilmen's first really healthy shout of triumph. Leduc began to tilt the economy of the West and ultimately of the nation. Leduc was an arrow pointing in the direction that Canadian power would shift. But it would be decades before this promise was fulfilled. And the labor had begun long before.

Debate still eddies over whether it was an American or Canadian who drilled the world's first well specifically intended to find oil. The Canadian contender is James Miller Williams, a carriage maker who built railway coaches for southern Ontario's fledgling railway. When his business took him to the London area, he met Charles and Henry Tripp, two brothers engaged in boiling bitumen from a local surface pit into asphalt for street paving and ship hull sealant. Theirs was the first oil company incorporated in North America — and possibly in the world. Another potential market appeared in 1855 when the Hamilton Gas Company reported that bitumen-derived lighting fluid burned 10% to 15% brighter than kerosene made from coal.

Mr. Williams bought out the Tripp venture when it faltered financially. Then this early entrepreneur built a simple refinery on the 600 acre site he'd just acquired. In 1857 he dug a well by hand, finding oil at 27 feet. In 1858 (or possibly late 1857) using a primitive drill he again reached oil, this time at 50 feet. The rig he used differed little from those developed by Chinese drilling through rock in search of salt.

The American claim is based on a well sunk at Titusville, New York by a colorful character known as Colonel Edwin Laurentine Drake. But the U.S. drilling occurred in 1859, at least a year after the success in Ontario. "Colonel" Drake's nearest approach to military life

appears to have been a spell as a railway conductor. Canadian authorities are inclined to regard his boast as being the world's first wildcat driller and his army rank as equally spurious.

But an enthusiastic American industry has spread his claim far and wide. What lent an air of credibility to the vaunt was the mushroom growth of the United States reserves compared to the puny Canadian field at Oil Springs. Nevertheless dozens of small companies swarmed into the Canadian strike zone: the first field's production soon proved unequal to demand. While the new-born oil outfits amalgamated into slightly more powerful units, another oil find was made eight miles away at what was named Petrolia. The price of a barrel of oil (35 Imperial or 42 American gallons) fluctuated wildly. Between 1864 and the year Confederation took place, 1867, the barrel price skittered from $4 to $11, then down to 50 cents.

As early as 1863 Canada had 30 refineries. Export was difficult. The sulphur-laden Canadian oil made kerosene that stank compared to the American product refined from the sweet crude of the new-found Pennsylvania fields. Once Canadian refineries had mastered that problem, the Ontario fields were unable to supply even local needs.

In 1880 a complex of small companies amalgamated into the Imperial Oil Company, now Canada's largest producer. In those early years petroleum processing quickly moved beyond fuel and asphalt to waxes, naphthas and lubricants. At this time the present massive refining facilities of Sarnia were begun, hard by those small Ontario fields. In 1898 Canada's first automobile sputtered down the street. The gasoline guzzling internal combustion engine would be the stimulus that eventually turned the petroleum industry into a world-dominating giant.

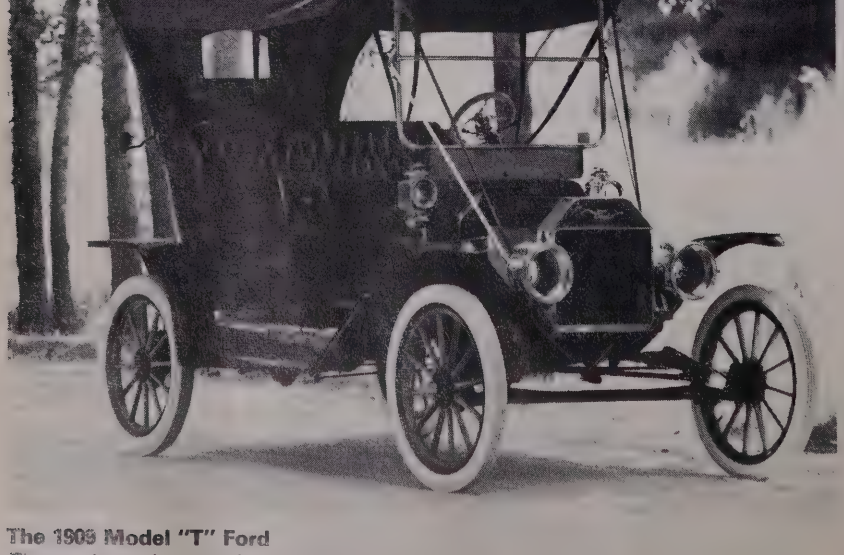
But the small Canadian companies, with weak cash resources, faced overwhelming competition even at home. Foremost was the Standard Oil Trust, which through control of American refineries had achieved both economy of scale and cheap access to vast American oil reserves. In 1898 Imperial was bought out by Standard. The only Canadian major to survive this early era without American capital was the British American Oil Company, begun in 1906 in Toronto. Even it would be absorbed half a century later by Gulf. European capital arrived in bulk with the formation of Shell of Canada in 1911, a subsidiary of the Royal Dutch/Shell Group. Ontario's oil production peaked in 1894 at under 90,000 barrels a year. (A decent Saudi Arabian well could produce that in a week.) For many decades Canada would be nearly totally dependent on imports. Then, 2,500 miles to the west, the nation's oil and gas industry would be reborn.

The pioneers who established the energy economy on which much of the west, particularly Alberta, thrives today followed a long, barren trail. Every small success was offset by much loss and disappointment. Yet talismans of hidden riches constantly drew them on. As early as 1788 the first European explorer to penetrate the lush fur lands on t Athabasca region, Peter Pond, report the existence of the tar sands. India used the black gum to seal their ba canoes. Another early lead came fr George Dawson, a geologist helpi catalogue Canada's resources for t National Geographic Survey of Canad Established before the Confederati the Survey can count many successe particularly in the Arctic, but the Da son incident did them little credit. M Dawson reported in 1870 the presenc of oil and gas in what is now Waterto National Park in southwest Alberta. F from creating a stir back east, it doubtful his document was ever read f years. This indifference was a presen ment of a persistent difficulty weste oilmen would face for 90 years to com Before it passed, a distrust of centr Canadian capitalists and governmen would change to active certainty tha they could not be relied on. Self relianc would be more than a virtue; it would b a necessity.

In 1888 John Ware, a cowboy with th unusual distinction in Alberta of bein part black, noticed his horse refusing t drink at a pond along Sheep Creek southwest of Calgary. He somewha rashly tossed a match onto its surface. burst into flames. That same year tw trappers in the Waterton region notice their Stony Indian guide was rubbing greenish-black salve on his back t relieve his aching joints. Intrigued, th two whites realized the ointment was high grade petroleum. In exchange for horse, the Indian showed them a sloug of black crude and all left well please with the deal. Later the man th trappers gave the information to, su veyor Allan Patrick, cajoled an elderl Indian lady to show him the source seep i exchange for food, a pony and a rifle.

The first man to exploit the find wa Alberta's original homesteader, Joh George "Kootenai" Brown. He soake the liquid up in gunny sacks, squeezed into bottles and sold them to th neighboring ranchers as lamp fuel an lubricant at a dollar apiece. Since hi methods were slow, Alberta's first com mercial oil producer didn't make muc money. But in 1902 the man who foun the seep originally, surveyor Patrick and a couple of partners sank a shaft a 1,020 feet. Western Canada's discover oil well flowed 8,000 barrels a day.

The hoped-for boom died abornin strangled by inadequate transportatio for the oil, poor drilling methods an equipment, and the failure of the nex three wells drilled to make commercia finds. But though the time was wrong



The 1909 Model "T" Ford
The mushrooming auto industry turned oil into very big business indeed.

An early Turner Valley rig with flare
Gas now worth hundreds of millions going up in smoke.

he place was right; much later the area ecame a substantial producer. In the neantine it was natural gas that gave he Alberta energy industry its first hoves towards maturity.

By the turn of the century Medicine Iat in southeast Alberta was supplied vith street lights and heat burning gas rom near-by fields. A CPR crew drilling or water nearby in 1883 first tapped west-rn natural gas. The well caught fire and he derrick burned. The town's supply vas discovered in 1890 during a search or coal. In 1906 a company called Calgary Natural Gas found natural gas within that city's boundaries, enough to upply street lights and another essen-ial frontier industry, a brewery. The nan behind this successful play would ecome a legend. Archibald Dingman ad been a roughneck in the Pennsyl-ania fields, then founded companies in Ontario making soap and bicycle brakes efore heading west.

In 1909 an engineer of French descent, Eugene Coste, began his climb to eventual fame and fortune with the Old Glory gas strike, a well flowing a remendous 8.5 million cubic feet a day. Following this with others, he was intent n piping gas to all southern Alberta but ouldn't raise money back east. In 1911, Mr. Dingman's Calgary Natural Gas oined forces with Mr. Coste to form the Western Natural Gas Company, ances-r to today's Canadian Western Natural Gas.

Within a year this pair was able to ecure franchises and financing to de-liver gas to Calgary by way of Leth-bridge via a 170 mile pipeline. Though the moves were hardly noticeable on a national scale (and the outfit was later bought by Philadelphia interests), Cal-garians were beginning to think energy. Heady times were just ahead.

William Herron was a name that would one day be virtually synonymous in southern Alberta with the determina-tion to build a Canadian-controlled gas industry. Though he started as a cook, then a company manager in northern Ontario's lumber industry, the man proved to have an amazing nose for minerals. Staking claims in what is now the Ontario silver town of Cobalt, he held land that would one day be worth millions. But by that time he'd sold most of his claims and moved to a 900 acre farm south of Calgary. There he took on a contract to haul coal. Travelling the prairie one day on coal business, he noted a gas seep bubbling on the bank of Sheep Creek. Sending samples to Ameri-can analysts, he confirmed that it was indeed natural gas, not worthless marsh gas. Shortly after he had filed claims on 7,000 acres of surrounding Turner Valley acreage, about 40 miles southwest of Calgary.

Turner Valley was to be the scene of a series of oil and gas booms; though not the first nor the biggest in the West, they were the wildest. William Herron, his cash all tied up in claims, had to sell real estate in Calgary while he tried to find backers to put up funds for drilling. He succeeded by batching up the most famous fried eggs in Canadian history. Organizing a little fishing trip with businessman Dingman, he used the Sheep Creek Seep to make breakfast.

The effect was electric. Mr. Dingman quickly formed Calgary Petroleum Prod-ucts, with $150,000 capitalization from a syndicate of local businessmen. Bill Herron was given 22% of the company's shares plus $22,000 and put in charge of a crew drilling at the site. Success now came quickly. At 3,924 feet the Herron rig released gushing natural gas soaked in a straw colored very light fluid. Lighter than conventional crude, the liquid is called condensate or naphtha gas.

Across the gently rolling prairie in Calgary the citizenry were already worked up to fever pitch. At intervals during 1913 reports of first gas, then oil had filtered though to the public as the drilling encountered encouraging traces. One newspaper speculated that Alberta might be the site of the richest field in North America, a claim based on enthu-siasm and fantasy. Even Mr. Dingman wrote a letter protesting "some of the absolutely irresponsible and ridiculous statements" being published. It had little effect.

The roar of Dingman Number One was all that was needed to fuel pande-monium. With Calgary Petroleum's di-rectors in the lead, cars streamed out to the site. Filling their tanks with unpro-cessed naphtha gas, many claimed they could drive more quickly on the journey home. The gas made a particularly sour smelling engine exhaust and its major market turned out to be the farm machinery of the prairies' growing grain industry. But Turner Valley first power-ed the drive behind hundreds of thou-sands of dollars of wild investment. From maids to millionaires, Alberta and much of Canada lost leave of its senses in a chaos of foolish financial speculation that later returned to haunt the fledgling industry.

The laws of neither nation nor pro-vince were geared to such an orgy. Fast buck operators could form phoney exploration companies and fleece a naive population with appalling ease. For a five dollar fee and 25 cents an acre anyone could file claims to mineral rights on Crown lands. Regulations automati-cally entitled holders of mineral rights to an oil company charter. During the original Turner Valley chaos, over 500 instant companies were created.

The streets were swathed with the banners of hawkers pushing shares as fast as they could be printed. Bankers later estimated that rank and file Cal-garians pitched over a million dollars worth of savings into these new com-panies. Yet less than one in ten ever

bought a drilling rig and much fewer yet found anything. By the end of the year most Crown leases on land along the foothills between the American border and Rocky Mountain House had been bought up. One Calgarian, a former preacher of hot gospel, carried the excitement east. Bringing a barrel of Dingman condensate to Toronto, he ladled it out free of charge to passersby on the street. Eastern money began flowing west, going nowhere worthwhile in most cases.

A tale typical of the early era starred a slick promoter who invited a Calgary priest on a fishing trip to a well known creek. Nearby the promoter had built a false drilling derrick. During the long day, while the priest fished, the promoter dumped a few barrels of oil upstream. Returning as the oil engulfed the priest fishing spot, the promoter apologised profusely for the annoying seepage. Once home again, the priest hurriedly bought all the shares of the shyster's company he could afford and let a good many of his friends in on his secret. At times in this period money was carried to the banks in garbage cans and cardboard boxes. Enthusiastic clerks would sell twice as many shares of a company as could be legally produced.

As time went on, another problem, this one technical, weighed even on the minds of the oilmen who profited from the practice. The Turner Valley field contained a mass of crude oil capped by a large field of gas. The crude was not reached for decades after Dingman Number One tapped into the gas. The light liquid naphtha was only recoverable if the natural gas it was saturated with was also retrieved. Besides a small quantity used by the city of Calgary, there was no market for gas. At today's prices over two billion dollars worth of Turner Valley gas was flared. Even worse, because much of the pressure of the gas was released before the science of reservoir engineering realised what would result, more than three quarters of Turner Valley's oil cannot be induced to flow to a well bore.

While successive provincial governments pondered the difficulties of overly sharp promotion practices and waste, western oil producers bumped down a rocky road. World War One quickly drew attention from the new Turner Valley field. Productivity from the field was less than anticipated. By 1919 with only two wells producing, Calgary Petroleum's processing plant burnt down. The impoverished company was sold to Imperial who in turn formed a subsidiary, Royalite, to handle the new properties. Though disappointed Canadian financing was unavailable, William (now nicknamed "Won't Sell") Herron opposed the sale to U.S.-owned Imperial. Long after he was still buying oil leases on his own. During the Depression he returned to hauling freight while his wife ran a boarding house. He died in 1939.

Royalite continued a half finished Dingman well, its famous Number Four. In 1923 at 2,871 feet this shaft hit the same gas encountered earlier. Drilling continued a thousand feet. By then Imperial's management wanted to stop. Enthusiastic local staff pressed ahead anyway. Just a scant ten feet further down a massive reservoir surged up the well bore with a tremendous (but largely useless) flow of 21 million cubic feet of gas a day and 60 barrels of commercially viable "water white gasoline" (more naphtha gas). For a decade this 350 million year old limestone bed was the target of Turner Valley drillers.

Meanwhile Imperial had been searching for crude at what was then the ends of the civilized world, just below the Arctic Circle along the Mackenzie River at Norman Wells. Oil seepages had been noted along the river by Indians and early fur trappers. In 1919 Imperial Oil organised eight geological exploration field parties to survey the vast flat sedimentary basin in Western Canada, stretching from the Canada-U.S. borde to the Arctic Ocean. The lower Macker zie River area was assigned to a 21 yea old American geologist chosen in par because a senior Imperial executiv noticed a picture of him standing on hi head on the edge of a cliff. Theodor Link, fourth son of an American minis ter, had the sort of nerve frontie exploration required. Arriving at th site 1,500 miles north of Edmonton i late August, Ted Link realized there wa almost certainly oil. The heavy worl around camp was done by an ox pur chased from a Hudson's Bay Company post.

The six men who had wintered there had drilled less than 400 feet. So weary had they become with their monotonous life that they had turned the ox into a satisfying Christmas dinner. Mr. Link despatched three of them south im mediately and had the rest help man hi new equipment. By August oil wa found. When the head driller ran to hi chief's tent to tell him oil was bubblin out of the ground, the 22 year old wh had just drilled the Northwest Terri tories discovery well said he didn't wan to be bothered until the spout reached the peak of the derrick. A while later the driller came yelling that the oil was nov blowing over the derrick's top.

In trying to exploit their claim ahead of the competition, Imperial subsequent

Dingman Number One blowing in worthless natural gas
"White water gasoline," and pandemonium.

y pioneered the use of planes into the Mackenzie valley. Meanwhile Mr. Link ravelled along the river with a bag of 0,000 one dollar bills, buying mineral ights from trappers and Indians. But hough the wells were productive, the ield proved too small to justify the xpense of building shipping facilities outh. So Norman Wells furnished the mall supplies needed by the North till World War Two. Then a pipeline was uilt to the Yukon, where the crude was efined for military operations against he Japanese in Alaska.

In the early Thirties Canadian governments were swinging into action at last o regulate oil company practices, both n promotion and production. In 1931 Alberta passed a law restricting Turner Valley wells to an annual production of 0% of their capacity to slow the urning off of natural gas. Subsequently he predecessor of the present Energy Resources Conservation Board (an indebendent body whose members are appointed by the province) was formed to oversee orderly development of the ndustry. Meanwhile the search for significant oil reserves in the south ground on.

No story illustrates the bullheadedness, hope and ability to raise capital required by those early oilmen better than the story of a well named Turner Valley Royalties Number One. The accepted theory was that the Turner Valley field consisted of wet gas and salt water. A small and uninfluential minority held that there was oil as well, collected along the west flank of the formation. A leading exponent of this generally scorned opinion was Robert Brown, an electrical engineer who was in charge of Calgary's electric lighting and street car systems. As a very well informed participant in his city's favorite speculation, Mr. Brown noted several things about the nearby "gas" field that many others ignored.

One was that a Turner Valley well had been producing naptha discolored by what the Royalite well supervisor in charge said repeatedly was crude oil. The man who published the first structure contour map of the valley in 1930, Dr. J.A. Goodman, recommended that the west flank be tested. New York geologist Joseph Sinclair believed pressure from the Rockies had trapped oil deep on the west side. Mr. Brown was willing to put his money behind his mouth. He began raising money to drill that west flank

He found some backers, including George Bell, publisher of the Calgary *Albertan* and Edmonton *Bulletin*. But lack of money stopped drilling seven times, once for over a year. In the end it is said that Mr. Brown mortgaged his home and spent the endowments he had previously allocated to his wife. Finally money advanced by Imperial, British American and two smaller outfits (in exchange for part of the results) allowed the well to be completed. On June 16, 1936 this determined character visited his drilling site. This time Robert Brown noticed flecks in the drilling mud. He asked that a sample be pumped out for examination.

Removing some of the drilling mud reduced the weight of the remaining column of mud bearing down on the bottom of the hole. With a mighty roar the well suddenly blew out, scattering the surrounding area with mud — and oil. Not only had Mr. Brown discovered Canada's first sizeable petroleum field, he had topped anything else in the British Empire. Though English companies were then opening up the phenomenal reserves of the Middle East, secure sources within the Empire's own territories were slim. Despite this, British pounds for exploration were not much more forthcoming than central Canadian dollars.

Perhaps the syndrome was inevitable, considering the hundreds of fly-by-night promotions in the past (though this was easily matched by the mining industry). In any case it was burned into the minds of the western oilmen, particularly after the great stock market crash of 1929, that theirs were not welcome faces in the boardrooms of the east. The Americans and the few western-Canadian based companies who were able to persist through the lean times were mostly well rewarded eventually with control of a profitable industry.

Canada remained overwhelmingly a net importer of oil, an unhealthy situation with the black clouds of World War Two forming on the horizon. Wearying series of dry holes and the lingering Depression had reduced exploration activities drastically and many oilmen were saying western Canada might be about played out. But a handful of corporations, mostly Americans or American-controlled, continued to try.

The long jinx is not remembered fondly by those whose livelihoods rested on oil. Gas finds were made here and

Spring, 1914: Sell, sell, sell!
The rip-offs during Turner Valley's boom soured many Canadi[ans] attitude to oil.

there but there remained no market. The war ended in 1945 with no breakthrough despite the fact hostilities had spurred the search to unprecedented levels. Finally in 1947 the tide turned. The limestone reefs below Leduc gave southern Canada its first truly prolific (constantly producing at a high rate) field. The price of the long wait: over 95% of the nation's production had passed into the hands of well-financed foreign owners. The Canadian sector would be revived by the new finds but its progress would be hampered by the powerful position the outsiders had earned.

After Leduc it was as if someone had pulled out a restraining cork. In 1948 Redwater, northeast of Edmonton, blew in. This field had well over double Leduc's reserves. In 1949 it was Golden Spike, northwest of Leduc. In 1950 Fenn-Big Valley was found; in 1951 Wizard Lake in Alberta and Daly in Manitoba; Acheson, Bonnie Glen, Nevis and Westerose came the following year. The massive Pembina find in Alberta was paired with Saskatchewan't Midale in 1953; Steelman was triggered in Saskatchewan the next year. For more than another decade western Canada was exploding with discoveries.

Inevitably, ironically, an oversupply developed. Canadian companies were hardest hit, since once more they had less financial resources than big internationals to ride out the situation. In addition the majors, whose large reserves in Canada could be reinforced if necessary from their overseas holdings, found it easier to get sales contracts. With few exceptions, eastern Canadian capital remained content to let the Americans and Europeans skim these rich takings.

Skillful, freewheeling, informal and friendly, the Texans arrived. The Canadians learned well, trained by the big companies and then splitting off to see if they couldn't get a better piece of the action on their own. The Americans' devotion to free enterprise struck a responsive chord among the western Canadians recruited into the business. And the Canadian oilmen were forced to learn to assess opportunities and take chances even the Yanks hesitated at, just to get toeholds. Many failed but not all. In the process the home teams became what they proudly believe is the most aggressive group in any major Canadian industry today. The famous caution of traditional Canadian businessmen just wouldn't work in the oil patch.

One of the few eastern financiers who did see the opportunity was Neil McKinnon, one of his generation's most influential Canadian bankers. His career with the Canadian Bank of Commerce began in 1925 when he became a 14 year old office boy. He'd reached his bank's number two spot when he met Robert Brown Jr., son of the pioneer driller who found Turner Valley's oil. The banker gained considerable respect for his western-bred friend as he watched Bob Brown maneuver brilliantly to the top of Canada's largest independent oil company, Home Oil. When Home Oil came east looking for a loan to buy Imperial's 38 Turner Valley wells in the post-Leduc boom, Mr. McKinnon made a prophetic decision. This industry would soon matter to all of Canada and he would push his bank into it. The millions of dollars he advanced to Home was secured by the oil under the 38 wells, Canada's firs production loan, and it was a key to th Canadian independent's rapid growth.

Such foresight was unusual. Mos Canadian independents (the term refer to companies producing but not retailin oil and gas) found the financial goin stiff. The Alberta government was th first ally to give them a major boost. I 1950 the Social Credit regime decide that the oil market would be split amon all the companies in proportion to thei size, a procedure called prorationing Thus in a glutted market the smalle companies could sell at least some o their oil.

Another step forward was the begin ning that same year of a network o pipelines that would carry western oil and gas to markets on the Pacific coast, the American midwest and eastern Canada before the decade closed. But as long as a glut continued, the west found it hard to compete with cheaper crude coming in from the mammoth (and therefore less expensive) wells of the Middle East and Venezuela. Control of the overall situation still rested with the consuming regions.

The plays continued across the west but, as each new ripple in the boom hit, old timers realized how orderly and tame life was getting. There was no lack of competition. Over 2,200 exploration companies of all sizes and types have lived and died in this country.

But legislation prevented any more harum scarum nonsense similar to the days of Dingman No. 1. Farmers' rights were protected. Incorporating companies were more carefully scrutinized. An auction system for selling oil and gas rights on parcels of Crown land were introduced. The offer of each competing bidder is secret, the highest bidder gets the rights, and not till the game is over do the contestants see the winning score.

Today the Canadian-owned sector of the oil and gas industry is rapidly increasing its ownership percentage of the total field. Three of the last five major discoveries in Alberta were made by Canadian independents. The glamor growth outfits of the industry today have names like Dome, Panarctic and Canadian Hunter among others. That trio and the bulk of the rest are Canadian. The issue of nationality has never meant much in the private sector of this energy industry and that is unlikely to change as the home teams increasingly branch into the United States and overseas. Still, knowing they've earned the respect of their peers around the globe does instill a certain confidence into the Canadians who search for oil and gas.

Spindletop — World famous Texas Gulf discovery well, 1901

Sired by Spindletop, the Texan oilmen later played key roles in the Alberta oil patch.

PANARCTIC

Energy depletion forced attention to the remote, expensive Arctic Islands. By uniting, Canadian organizations dominate this new field.

Slowly Canadians are taking control of an ever greater share of their country's oil and gas industry. In the pioneer stages of Alberta oil, central Canadian financiers repeatedly refused to invest in a high risk business they knew little about. Their indifference earned them the enduring resentment of westerners and, by default, threw a vital sector of the economy into the more adventurous embrace of American multi-nationals like Exxon, Gulf and a dozen more. However some Canadians, mostly trained by these companies, used their wits to stake out smaller pieces of the pie for themselves. Meanwhile elsewhere other Canadians were learning the extent of the opportunity they'd missed and were becoming more determined to participate.

As a direct result, the vast potential of the High Arctic is primarily in Canadian hands. While the major U.S. and European companies remained leery of the high risk and costs involved here, Canadians marshalled their courage and immense capital required to plunge in. Though the necessary air transport had been developed and, after 1947, a string of airstrips built for weather stations provided access, the multi-nationals had only sent in a few preliminary search parties by 1960. That year the Canadian government laid down the basic rules regulating energy exploration in the islands of the far north. An explosion of land claiming followed.

But the oil industry giants held back, allowing the exploration rights of tens of millions of acres to fall to small and medium companies, mostly Canadian. The thinking of the big international money pools was partly that there was no point in creating competition for the vast reserves they controlled in Venezuela and the deserts of Arabia. Those apparently inexhaustible reservoirs were a good, cheap source for whatever percentage of the Canadian market wasn't being supplied from their fields in Alberta. Besides, they had their eyes on the more accessible Mackenzie delta.

If the Arctic islands really did hold reserves, the small folk who had bought the rights would likely be unable to raise the tremendous amounts of capital necessary to develop them anyway. The giants estimated that if it ever mattered, they'd probably be able to move in at their leisure. They were wrong.

King Christian blowout flames into the Arctic gloom
A technical setback, a publicity bonanza.

In a series of hesitant and sometimes muddled moves, a motley consortium of visionaries, the federal government and 19 companies, most Canadian, put together an organization capable of coping with the challenge of the High Arctic. That seed was born in the mind of a highly respected Calgary geologist, John Cameron Sproule. Colleague of the pioneers whose work was establishing a Canadian-owned sector within the industry, Cam Sproule was among the first geologists sent into the Arctic by various oil companies. He became so enthralled by this vast land that eventually he did exploration work there at his own expense.

Despite the impression in the minds of southerners, the Arctic is a land of variety. The continental coast and the Mackenzie River delta are positively lush with vegetation and animal life compared to the truly forbidding regions among the more northerly islands. There the land is mostly flat, a rubble of stones sparsely strewn with tufts of plant life. The growing season is as short as two weeks. Flying over this land scraped clean by repeated glacier invasion, Dr. Sproule was impressed by the enormous Saudi-sized potential reservoirs formed by the architecture of the geological formations. Of course those reservoirs might be empty.

In the mind of this explorer evolved the concept of a consortium of the companies with rights in the area. Individually they were too weak to carry the load they had taken on but together they could do the job. Only a few years from death, Dr. Sproule fought to bring together the members necessary to create this team. Preliminary progress was good. But then, every time it appeared he had mustered enough, a key company would get cold feet. In his words, it was like trying to hang onto a handful of worms.

The Canadian government was interested. Developing useful resources in this hitherto economically idle area would reinforce the Canadian presence in the islands. Not all countries formally recognize Canada's sovereignty over all the Arctic islands she claims. Two powerful subsidiaries of the Canadian Pacific group, Cominco and Pancanadian (mining and energy), also grew actively interested in the Sproule mission. In the end, the Canadian government under Lester Pearson decided to buy in, taking 45% of the company and providing the reassurance necessary to draw in the 19 private companies, whose share of the equity was 55%. Initial financing was $20 million.

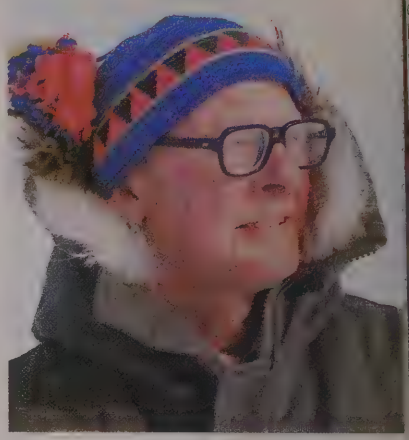
Thus was born Panarctic Oils in the year 1967. In order to keep the leases for 35 million acres they'd amassed, the fledling company had to undertake a formidable program of exploration. Initially one of the consortium members, Dome Petroleum (who in 1962 had spudded the islands' first well) actually did the work under Panarctic's direction. But the company soon began organizing its own staff, slated to take over the entire operation by 1971.

The man who has since headed Panarctic as it inches toward commercial viability is Charles Hetherington. His parents, though Canadian born, lived in Oklahoma when he was born in 1919. In that place and time bankers such as his father carried guns to deal with the likes of Bonny and Clyde. As a boy, Charles was hard-working but shy; the work habit remains but the reticence has long since been transformed into the easy confidence of a master promoter. When he graduated from the University of Oklahoma with a Masters in chemical engineering in 1941, he won a scholarship to the world famous Massachusetts Institute of Technology.

While earning his doctorate and for the remainder of the war, he did defense research, part of the time helping to set up refineries to produce synthetic rubber. Then for seven years he worked for Ford, Bacon and Davis, a consulting engineering firm in New York that had designed every North American gas pipeline, including a couple in Alberta. He met Frank MacMahon, a man who was broke till an oil blowout in the Leduc field netted him $4,000,000 once it was brought under control six months later. Practically every newspaper in the civilized world ran pictures of this gusher. The mishap put Leduc on the world map, a lesson Mr. Hetherington later recalled to Panarctic's profit.

Mr. MacMahon dreamed of a pipeline 600 miles long from the Peace River gas fields to Vancouver. He convinced the 33 year old American engineer to become vice-president and chief engineer of his Westcoast Transmission Company. By 1956 the Fort St. John - Vancouver line was a reality, costing the then enormous sum of $156 million. Recalls Mr. Hetherington, "There was no talk of the environment then. The government guys we dealt with were the Board of Transport Commissioners, who ran railways and stuff like that. When they asked for a survey of the proposed route, we said we didn't have money to waste and we'd tell them exactly where the pipe ran once we'd put it in." The ecology of central British Columbia seems to have survived well enough.

When Mr. MacMahon's empire grew with the founding of Pacific Petroleum (netting him $25 million when he eventually sold it), managing director for the new company was Charles Hetherington. Pacific supplied the Westcoast pipeline with gas. In 1957 Mr. Hetherington struck out on his own for eight years, founding a consulting firm carrying his own name as well as an investment outfit, Cancrude Oil and Gas. "I made about a million doing this, then went back to Westcoast. But I got bored." When he saw a magazine advertisement for the top job of a hefty oil company, he was interested enough to nose around till he found out who it was. He applied. In 1970 he became president and chief executive officer of Panarctic Oils, his present job. In 1968 Panarctic had seismic crews on the move and was setting up its key base at Rea Point on the east coast of Melville Island. Next year the first exploratory wells were spudded by rigs flown in by Hercules aircraft. At Drake Point on Melville the first gas discovered blew out a well. Water driven skyward by erupting gas formed a frozen vertical cone 225 feet high that still stands. It wasn't brought under control till a month after Mr. Hetherington was hired in August, 1970.



CHARLES HETHERINGTON
Panarctic's president

Another month passed. Late on the night of Oct. 29 the new chief was

ARCTIC SCULPTURE
This blowout froze into a cone 225 feet high.

vakened from sleep. Over the phone ame the message that another well had blown wild when a rig tapped into what vas to become the King Christian Island gas field. This time the gas caught fire. Flowing at a flood tide rate later estimated at 400 million cubic feet a day, he well spewed a flame that could be seen 300 miles away. At six a.m. a sombre meeting of Panarctic's managers, grateful nobody had been hurt, made arrangements to put out a fire over 2,000 miles north of any city in a and of 24 hour darkness in temperatures of 50 degrees below zero.

Arctic barge / Kodiak system

Another meeting was held not long after at Rea Point between the then minister of northern affairs, Jean Chretien, and Charles Hetherington. The flames were igniting headlines and the politician was worried. A Panarctic director flying on the polar route to Europe found out just how well known the site was when the jetliner's pilot suggested passengers should take a look at the flaming well that could be seen out the window. Under these circumstances the Canadian government would be very interested, Mr. Chretien intimated, in knowing what Panarctic intended to do.

Charles Hetherington was not at a loss for words. When the conversation ended, Jean Chretien shook his head and said, "I hope your idea works. But I warn you, one more blowout and Canada will have a new minister of northern affairs, Panarctic will have a new president." Free to act, the company president was soon hastily calling his many acquaintances in the gas buying end of the business. Soon a planeload of 16 of the industry's most powerful executives, mostly Americans, was winging northward. In the MacMahon tradition, disaster was being turned into public relations.

By January crews working in blizzard conditions had mounted a successful assault on the blaze using sea water, drilling mud, and cement. But Mr. Hetherington was soon in another battle, this time with his federal government sponsors. By and large the government/private sector partnership has run smoothly. But the Ottawa mandarins grew alarmed when the Panarctic boss came up with a $75 million funding proposal he'd worked out with four major American gas buying companies in the aftermath of the tour to the King Christian fire. The feds were deeply suspicious that the Yanks might be trying to pull a fast one to get some sort of control. And, though Charles Hetherington became a Canadian in 1956, perhaps they weren't quite certain there wasn't left in his heart a little Yankee blue along with maple leaf red and white.

In one board meeting the chemical engineer even tried a quote from Shakespeare's play *Julius Caesar*, suggested to him beforehand by his wife Rose: "There is a tide in the affairs of men which, taken at the flood, leads on to victory; omitted, all the voyage of their life is bound in misery and sorrow." One opponent then suggested the Panarctic president might be going crazy. In the end the deal went through. For their millions, the four companies got first crack at buying Arctic Islands gas. However they only get that chance if and when the National Energy Board of Canada declared the gas in question surplus to Canada's own needs. Otherwise they get their investment back from the profits of sales to others.

By 1973 land holdings had risen to 82 million acres. Capitalization had passed $100 million. That year the 3,500 mile sealift from Montreal had hauled in 43,000 tons of supplies to the year-round Rea Point base. A test well set a new Arctic depth record.

A fifth gas field was found. The native employment program had succeeded in training Inuit (Eskimos) as carpenters, electricians, mechanic's helpers and, in one case, as a fully qualified radio operator. A 600 mile shuttle system had been set up between the worksites and these workers' two home villages, Arctic Bay and Pond Inlet on Baffin Island. The regular shuttle allowed regular time off and ended a high job turnover rate. Even what few caribou, musk oxen and white fox roamed the unpeopled prospect area held by Panarctic appeared to be undisturbed by the company's activity.

The great stride forward of 1973 was the formation of the Polar Gas Project to examine the possibilities of a pipeline south. Panarctic joined three other companies to form the project, including an American, Tenneco, plus TransCanada Pipelines and Canadian Pacific Investments. The government of Ontario joined later. And 1974 had its good moments. Traces of oil were found by one drilling rig, the first such sign. And for the first time a full size rig used the ice itself as a platform while drilling offshore. The ice was flooded repeatedly till it was 16 feet thick, strong enough to support the specially equipped drill. Ice movement had been carefully measured

Supply ship unloading at Rea Point
A lot has gone in but so far nothing has come out.

Proposed ship and pipeline routes south
A potentially powerful reinforcement for the Canadian presence in the Arctic.

for three years. The new technique cost only one quarter of any feasible alternative.

But tragedy struck again. A Lockheed Electra carrying workers back to the job from Edmonton crashed a mile short of the sand runway at Rea Point. Thirty two men died. Two of the plane's three pilots were the only survivors, escaping death when the nose cone broke off and skittered across the sea ice. Panarctic maintained strict official silence while the coroner wondered aloud if the company's safety precautions had been below par. The media roasted Panarctic with doubts about its radio, radar and other navigational aids and scathingly attacked its rigid silence. An official government report routinely compiled on the tragedy (as usual with all air accidents) appeared to many not to get to the bottom of the matter.

Finally a judge was appointed to conduct a judicial inquiry. "We were completely cleared of any negligence or guilt of any kind," recalls Charles Hetherington. "The silence that seemed so suspicious was forced on me by our insurance company. If any public statement we made in any way prejudiced the legal battles they anticipated might occur, our coverage would be void. But I can tell you I spent many a frustrated night lying awake and wishing I could clear our name aloud."

The work went on. In 1976 the Arctic Pilot Project was formed, a consortium of companies headed by the Alberta Gas Trunk Lines and the Canadian government. Their first move was to examine the feasibility of piping gas south to Bathurst island, an area more accessible to liquid natural gas (LNG) tankers than the production zone. These ice-breaking LNG tankers would haul the fuel to market down the Atlantic coast.

And that same year Imperial, Gulf and Petro-Canada agreed to put up a piece of exploration costs in exchange for a share in any finds. The giants were joining but the Canadians were in a position to make good terms. In 1978 Panarctic hooked an offshore gas well to shore with a very sophisticated pipe-laying technique they developed with help from the federal government. It was another first in Arctic waters.

As of 1979 Panarctic's financing stands at $250 million. For the four hundred million they've spent, not one cubic foot of gas has reached market. Competitio from vast new fields in Mexico and fro growing reserves in Alberta, all closer t market, is a fact of life. Gambling on thi scale takes a certain nerve. But Pan arctic's chief is nowhere near surrender For one thing, even the very conserva tive National Energy Board estimate credit the Arctic Islands with 9.7 trillio cubic feet of gas reserves. The Arcti Pilot Project calculates that two trillio are enough to financially justify setting up LNG shipping facilities. With tha cash flow it's hoped Panarctic can find the 15 to 20 million trillion cubic fee necessary to justify building a direct pipeline all the way to southern markets.

"I believe we've a minimum of 13 trillion cubic feet already," estimates Mr. Hetherington. If so, he's found gas at an exploration cost of 3 cents per thousand cubic feet, compared to costs in southern Alberta of perhaps 40 cents for the same volume. One oil well they've drilled can produce 5,300 barrels of crude a day, a very high figure. But thus far not enough reserves have been found to justify shipment. New wells cost between two and eight million dollars to drill. The steady stream of new finds at a very high drilling success ratio is the only reason Panarctic's cost of exploration per unit of gas found is so low.

There have been more immediate benefits. The Inuit of two villages have been paid close to four million dollars and appear to be on the way to forming a stable, skilled supply of manpower. In recent years as much as 25% of Panarctic's northern crew has been recruited from that source. In 1977 Panarctic employed 83 Inuit and the system of education and co-existence they've worked out could be valuable on a wider scale.

The habits of the rare animal residents of that stony desert (rainfall as low as 2.5 inches annually) have been catalogued very closely. Systems of laying underwater pipe in the far north have been developed to a world-leading degree. Other cold weather technology worked out is equally advanced. Nevertheless the road still winds ahead and financial success remains elusive yet. The vast reservoirs of the Arctic geological structure are definitely not full to capacity but a gigantic bonanza could still lie ahead. What's been found is distinctly heartening to people and Canadian governments fearful of diminishing world energy reserves. The gutsy tenacity and vision of people like Cam Sproule and Chuck Hetherington may yet bear fruit in the eerie emptiness of the true north.

EATING

Camp life's prime pleasure.

Helen McCormick, Arctic cook
"Roughnecks are more likely to be gentlemen."

A lady who habitually lives with dozens of men in isolated areas needs a strong character to cope. So says Helen Katherine McCormick, a 37 year old cook who since the age 13 has been feeding oil workers, loggers, and farm crews, even Eskimos. She recalls standing on the second floor of her parents' hotel in Alameda, the centre of the southeast Saskatchewan Steelman oilfield, watching the flares lighting the night sky. There her mother in the Fifties tutored her in the cooking trade, satisfying the stomachs of the young roughnecks that crammed every corner of the hotel and the house in the village. The young girl gained a respect she's never lost for the free-spending, hard working oil hands always willing to dance or fight.

True, in 1959 she deserted the oil patch for the logging town of Golden, B.C. where for years she honed her skills on appetites from hoboes' to the visiting Archbishop of Canterbury's. She liked the loggers. "They were good boys at heart. No one ever used knives or guns." Still, she adds, roughnecks are "more likely to be gentlemen." So the short, energetic brunette willingly accepted when she got a chance in 1969 to go to work in a modern portable camp in the gas fields of northeast B.C.

By coincidence the company she went to work for bore her own maiden name, Fortier. Begun 30 years ago in Peace River and long Alberta's largest caterer, Fortier now typically employs 500 and has handled projects with populations up to 4,000. But most camps are still much like the aluminun-skinned buildings Helen McCormick first went to work in, housing just a few dozen rig workers. She found cooking in her new circumstances had its own challenges. But the worst wasn't the men themselves. She laughs, recollecting the fears that prompted her to pack a .22 pistol when she first arrived.

"The worst is moving day," she says with certainty. The long flat-decked trucks that will haul the camp up to 30 miles start arriving as early as 4 a.m., taking advantage of the frost-hardened ground if it's spring or fall. By 7 a.m. the cook must feed her own crew of about 25 plus 30 or more truckers as well as getting everything packed to move. Dishes are wrapped in sheets and put in the big stainless steel sinks. Cans and bottles are boxed on shelves, the refrigerator door is taped to secure its bulging contents, and the heavy grill is removed from the large gas-fired stove.

Accidents happen anyway. On one occasion in the McCormick career, a five gallon pail of corn syrup erupted into her fruit boxes. Eggs shatter and stove gas lines frequently snap. Since supper must be served at the end of a long day no matter what, even if it's past midnight, the wise cook prepares in advance a large ham and a dozen or more pies. Candles are often used to melt snow for coffee before the camp's huge generator is set up once more. In a pinch bacon and eggs are always popular. "I've never gone to bed after a move without being thanked by the men for my trouble," she comments.

A cook's normal routine is easier. Around six in the morning it's time to start preparing breakfast, lunch, and supper, all at once. While the water's heating for poached eggs, the various roasts, birds and other long-baking items are readied for the oven. An efficient cook can get a couple hours nap in the early afternoon. Supper activities on a drilling rig are over by eight o'clock but a seismic crew can keep the kitchen busy till midnight.

Unless there are separate quarters available, the cook, the kitchen helper and the camp attendant are male. Some crews prefer men anyway. But every year the quota of women rises and they go further into the more isolated areas. Says Helen McCormick, "Somehow with a couple of women around, morale

is often higher. But to succeed you have to stick to the rules. A woman may feel it's neighborly to allow rough talk in her kitchen but in fact she'll lose the crew's respect. Just like dealing with characters tracking grease and mud in on their boots or coming to eat unwashed, it's better to firmly draw the line and say no. They complain but inside they prefer to be civilized."

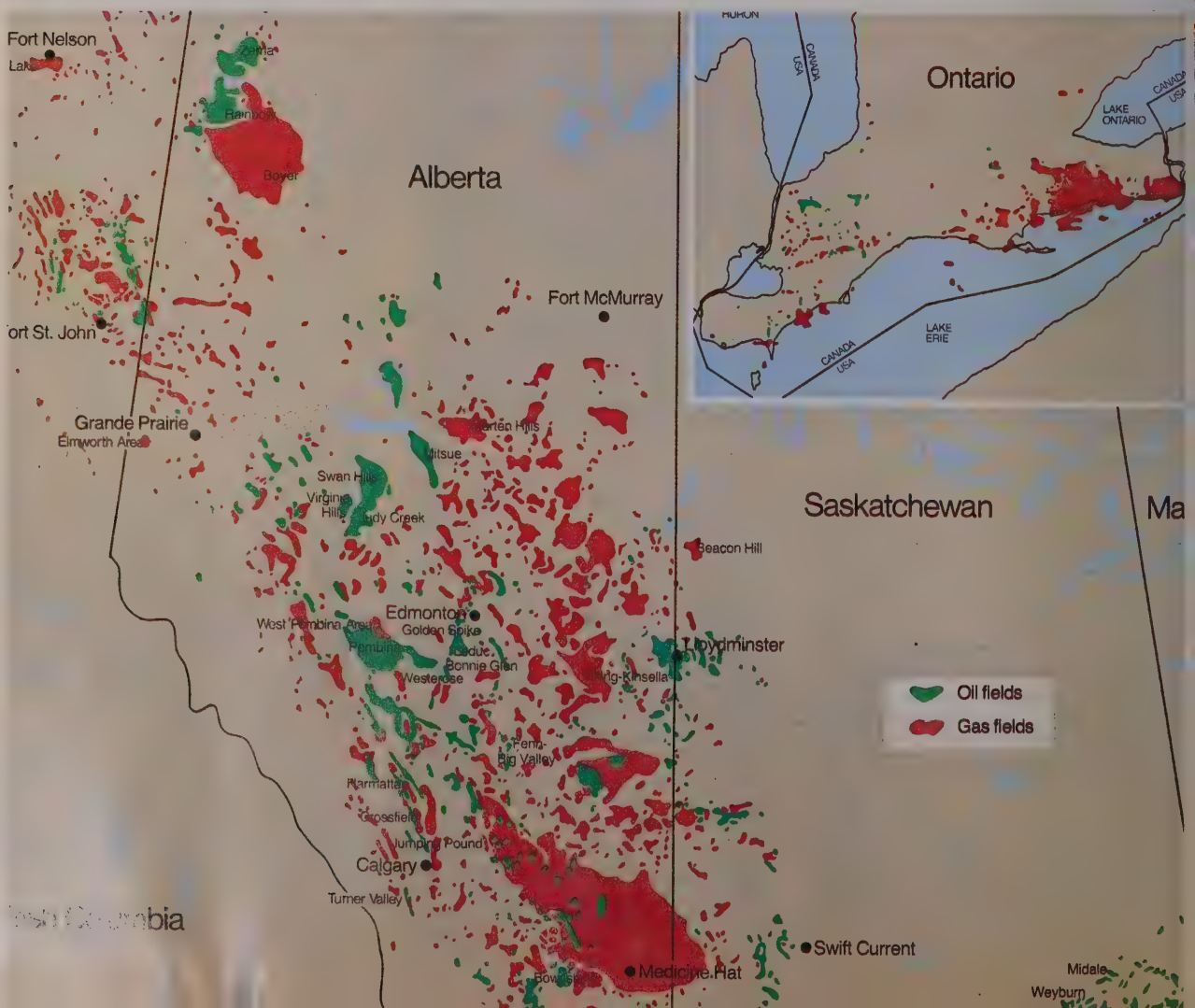
Sex, like bringing in drink or children, is forbidden in camp. In practice all three do occur on occasion. "Again it's better in the long run to keep it clean if you want relations to go smoothly," dictates the McCormick credo. She says she's never been seriously bothered and deliberately left her door unlocked to show she trusted her companions. "Just one time I was worried. The head of the crew decided to pound on my door and yell his fool head off. But it amounted to nothing." If the crew has learned to respect a woman, she believes, the men will protect her with unswerving loyalty.

Mrs. McCormick eventually cooked across Alberta and up into the Arctic islands. "The Arctic crews were especially fine, handpicked guys with a morale almost like a family's." Once, when she left the bush for a short stint in an Edmonton hotel, she recalls her eyes filling with tears as she watched a Panarctic jet streaking north towards the islands. One of the best aspects of camp work is time off, one week in four for Arctic kitchen crews. "People's voices and the colors all seemed livelier. And I loved taking $1,000 and hitting the shops." Normal camp cook's wages in Alberta are $4.25 an hour, ten hours a day, seven days a week, guaranteed.

A year ago Helen McCormick left Fortier for Crown Caterers, an upstart rival begun in an Edmonton garage and now Fortier's largest Alberta based competitor. Her job: hiring personnel and making sure their work stays up to par. The worst curse of the camp cook is alcohol. Some of them can only work away from all temptation. Mrs. McCormick herself recalls a fellow worker having a fit of delirium tremens in her room.

On the other hand, she can push hard to supply the home-cooked-from-scratch meals she believes in and oilmen love. "Too much of life these days is tinned and tasteless," says this determined lady. The foodstuffs and equipment these days is the best available. Living with her husband John, a fellow Crown manager, and their two children pleases her well. Still, Helen McCormick misses the times when everyone knew she was the most important ingredient in a happy camp.

Major producing oil and gas fields



RESERVES

Measuring the unknown

Anyone who burrows often into the nether sections of any Canadian daily newspaper will come across undefined references to the nation's reserves of oil and gas. The plethora of terms can seem almost endless — proven reserves, potential reserves, plus more that are possible, present, known, estimated, tight, locked in, recoverable, economic, conventional and so on and on. Occasionally they erupt into front page headlines as different parties, all apparently experts, disagree completely on how much energy reserve there is and how it should be handled.

No one can know absolutely for certain how much reserves there actually are or what is the best policy for exploiting them most effectively for the common good. Yet these decisions must be made. The issues are at the heart of Canada's and Alberta's economic health, both now and long into the future. There are serious possibilities for political strife between the western region, intent on industrialization requiring massive energy-acquired capital, and a central Canada determined to secure future energy supplies as cheaply as possible. Though final, proven answers are unavailable to anyone, expert or not, some of these questions and their inferences can be put clearly in layman's language.

The major players in the field are the provincial and federal governments, the major oil companies individually, the Canadian Petroleum Association, (CPA), the Independent Petroleum Association of Canada (IPAC), the National Energy Board (NEB) and the Energy Resources Conservation Board (ERCB). An increasingly vigorous voice of late has been the Committee for an Independent Canada (CIC). The CPA is the association dominated by mammoth oil companies who combine production, refining, and retail distribution capabilities into single organizations with names like Shell and Gulf. IPAC's members are primarily petroleum producers with no "downstream" distribution operations, companies that are usually smaller but nevertheless a major industry factor. The NEB and ERCB are both independent permanent commissions, the first financed by the feds, the latter by Alberta. Broadly, both advise their governments on energy policy best suited to serve the public interests plus they make sure industry adheres to those government regulations.

Fortunately these organizations recently agreed to a common set of reserve terms, ending the era when each talked its own language to the intense confusion of onlookers. For estimates of reserves thought to be virtually certain, the label now is "established reserve." A second term refers to this established reserve plus the quantity of resource that will likely be found in future in deposits that can be economically recovered. The words for this total are "ultimate potential."

A trillion here, a mere billion there ... a guessing game as complex and critical as any in humankind's troubled history is being played across the world oil patch.

What are Canada's established reserves? The NEB figures Canada in 1977 had 5.8 billion barrels of oil and, as of 1978, 80 trillion cubic feet (tcf) of natural gas. The ERCB estimates that Alberta's established reserves of natural gas totalled about 60 tcf, of crude oil five billion barrels from conventional sources. Another 22.6 billion barrels can be extracted from oil and tar sands. Historically NEB, ERCB, and the Canadian Petroleum Association's estimates of established reserves have been roughly in agreement. Where figures can vary wildly is the ultimate potential, regarding natural gas. At the end of 1977 the ERCB noted Alberta had 110 tcf of natural gas as ultimate potential. Inquiry spokesmen put that figure in a range from 105 tcf (Gulf) to 195 tcf (PanCanadian). Mavericks claimed many hundreds of tcf. For all Canada the NEB this spring estimated an ultimate potential of 147 tcf.

For a decade Canada's reserves of conventional crude oil have been dropping. In Alberta at least, Saudi Arabia-sized discoveries are considered virtually impossible and what major finds are being made come further between all the time. No one argues that the country needs to keep as much of this production as possible for its own use. What can make tempers flare is the question of natural gas exports to the United States. In the last few years Canada has been exporting 30 to 40% of its production south. At the same time a rapidly rising price combined with government tax incentives stimulated private industry to explore for more. New gas reserves are now being proved at a faster rate than ever before. Industry naturally wants to sell enough gas to recover costs, make profits and raise capital for more exploration. Government, especially at the federal level, backed by eastern consumer provinces and groups, is calling whoa to western export enthusiasts.

One basic difficulty is that eastern Canada at this time can't consume the gas as fast as Alberta producers can deliver it. For many producers, to whom waiting means additional costs and, in some cases, possible bankruptcy, the self-evident solution is to sell the surplus to the United States. The U.S. at one time was willing to gobble up far more than the 5% of her total gas requirement that Canada now provides for her. Canadian producers are afraid that if this country sits hemming and hawing, vast new discoveries of gas in Mexico will provide an alternative source. And higher prices are stimulating new production in the U.S. too. That could leave Alberta's producers with only a small Canadian market to turn to, at least for many years. Thus speaks, among many voices, IPAC and, less forcefully, the more cautious CPA.

Eastern Canada, fearful of being forced to rely on vital supplies from unstable regimes like Iran, is determined that no producers' lobby will force quick profitable sales to the U.S. of gas Canadians themselves may need a few years hence. Alberta itself protects its interests by refusing to license exports to either the U.S. or other provinces unless Alberta's likely needs for the

next 30 years are safely provided for in proven reserves. However this restriction wouldn't interfere with applications presently before the ERCB asking permission to export between eight and nine Tcf to the U.S., a figure that could easily go higher yet.

However this spring the NEB decided to recommend to the federal government that only two Tcf of natural gas be allowed federal export permits. While some producers hailed this as a forward movement, others lambasted the Board for conservatism. The NEB reached its figure by deciding what were Canada's established reserves of natural gas, what the likely market was for them over the next 25 years within Canada, what amount of those reserves could be actually delivered over the next ten years and decided two Tcf were surplus to these basic requirements. Since all these considerations are inevitably open to doubt, western attackers did not lack for ammunition.

From the melee of dozens, two gladiators may be picked as representing views that are generally considered aggressive but within bounds of convention. Andy Potter, as IPAC's regulations manager, speaks before innumerable offical hearings, ploughing through thousands of pages of technicalities to produce hundreds of his own. This mild, genial engineer is respected within the industry for his 22 years' experience with consumer, pipeline and production companies and his closely reasoned position papers. For the other side, Bruce Willson, former chief of Northwestern Utiltities of Edmonton and Canadian Western Natural Gas of Calgary, is a past national chairman of the Committee for an Independent Canada. Retired at 57 in Ontario, he spent most of his life in Alberta. In his opinion, "The interests of the country and especially the consumer have been badly neglected in the past so I decided to take a hand."

Mr. Willson scorns the idea that Canada has really proven any major reserves recently. "At the recent NEB hearing I challenged anyone in the industry to show even one gas find with that major established reserves that we hadn't known all along. What people are finding now we always knew was there — shallow gas in low yield geological formations that were uneconomic till these massive price rises. Western Alberta's newfound tight reserves (gas that move only very slowly through dense rock and shale to a well bore) are not counted by either the NEB or the ERCB as established economically exploitable reserves. The point is combined established crude oil/natural gas totals taken together are declining and there's no certainty we'll unearth any gigantic new finds." Mr. Willson, noting that Canada already can't fully replace the 600 to 700 million barrels of crude consumed annually, insists that high exports are a foolish gamble that new discoveries will continue.

Andy Potter is equally convinced Canada should sell. "Gas reserves are climbing, even in official estimation. In fact even discounting work going ahead in the Arctic and Atlantic as well as the tight formations of Alberta, ou estimated reserves will in my estimatio continue climbing.

According to Mr. Potter, cutting bac sales will cut back discovering ne reserves. When needed again, men wi have to be trained and machinery bough once more since the lull will hav scattered what was once available acros the globe. Premier Peter Lougheed though he concedes Alberta must cor sider Canada's needs first, has echoe the need to keep the search going.

Nor is there an agreement on th potential market Canada can provid Bruce Willson, like many others, claim eastern Canadian industry can switc some crude oil consumption to ga Eastern Quebec and the Maritimes, no nearly totally dependent on foreig sources, he believes should be brough into Alberta's market by new pipeline Backed by some authorities in th regulatory board circles, Mr. Potte doubts eastern oil refineries will give u markets easily; faced with natural ga competition, they might well just lowe their prices on competitive products notably the heavy bunker oil left afte more valuable products are refined ou of the crude. "They'll have to do some thing with it," notes one ERCB official

The Committee for an Independent Canada wants a comprehensive govern ment energy plan designed to preserve the industry and its products for Cana dian owners. "The energy field is 90% foreign-owned and concerned with profit and foreign interests," charges Bruce Willson. (Both Northwestern and Cana dian Western, suppliers of most of urban Alberta's retail gas, are controlled from Philadelphia.) A fact of life, though it's actually 73%, rejoins Mr. Potter, point ing out that Canadian companies are operating from Vietnam to Europe's North Sea. "I don't believe that complete government planning would prove any wiser than the operation of a free market. In the U..S government at tempts to force natural gas users onto the more abundant coal just nudged industry towards crude oil so now they want them back on gas." Mr. Potter doesn't believe Canada would be wise to hoard its marbles and refuse to play "We'll never be short of energy as long as we keep progressing technically. We have massive coal reserves, oil sands and who knows what's around the corner. If we lose faith and just try to cling to what we now have, I firmly believe we'll lose."

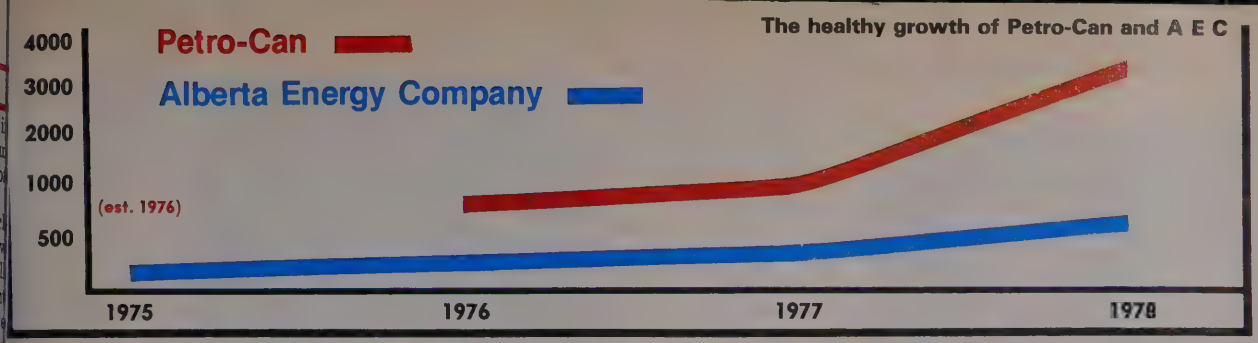
In one vital area, many westerners and easterners agree. Canada should keep pouring capital in the search for more energy.

Who owns Canada's oil and gas?

One of Canada's enduring myths is the supposed total domination of the oil and gas production industry by foreign multinational companies. This fallacy generates considerable resentment, particularly in eastern Canada. But the truth is, according to the federal government's Foreign Investment Review Agency, the industry in 1974 was 43.1% Canadian-owned. By comparison, the country's manufacturing sector was 47.8% Canadian-owned in 1974, the last year statistics were compiled. This 5.7% gap has undoubtedly closed in the meantime and may indeed be the other way around now since the Canadians' share of oil and gas activity has been rising dramatically in the last five years.

The bulk of this country's investment capital remains under the control of central Canada's private and public leaders. So loud nationalists from southern Ontario might learn something if they examined carefully one of the subtler aspects of the Foreign Investment Review Agency's energy statistics.

Though over 43.1% of the total oil and gas production investment in Canada is Canadian, the manner in which it is invested means only a little more than 25% of the industry is Canadian-controlled. In 1974 American companies controlled 59%, other foreigners 16%. What this means is that a great many Canadian dollars are being invested in those resented foreign multinationals. And the bulk of those dollars are from central Canada, the first region to cry 'foul' over foreign domination of Canada's oil and gas. But even that 25% figure is a tremendous boost over a couple of decades ago, a rise that has coincided with the emergence of western-based Canadian oil and gas exploration companies.



GOVERNMENT MUSCLES IN

Will Petro-Can and the Alberta Energy Company help or hinder efficient energy development?

In the mid-Seventies twelve of the world's fifty largest corporations were oil companies, double the representation of any other industrial sector. Yet, remarkably, never have these gargantuan energy seekers and sellers been more threatened than they are now. Like the giants of an earlier eon, the dinosaurs, their domination is threatened by a change in the climate . . . in this case the political climate. Doubtless they will survive, diversifying into other energy fields like coal and even unrelated activities in service and manufacturing. But their era of supremacy is already visibly waning. Tyranosaurus rex may soon be just another lizard.

The world's governments, faced with shortages and tremendous potential for profit, are determined to wrest more control of the oil industry from the private sector. They use two basic methods, regulating the industry and creating government owned energy corporations. Many subtle combinations of this pair are now being evolved as well. In the United States, the home of most of the private sector giants, regulations of national and state level have become an administrator's nightmare. American experts are on record as saying that the rules of different regulating agencies are so contradictory at times that a company literally cannot keep from breaking the laws and every major U.S. operator is now in court for such infractions.

Canada has gone a somewhat different route. Though oilmen here also do complain about the amount of regulation they face, the government moves most vociferously resisted have been the formation of a series of Crown and quasi-Crown corporate competitors. In Alberta, the Alberta Energy Company was formed in 1974, with the provincial government holding half its shares. SaskOil is a government venture pure and simple. But the development most opposed by Canada's oil and gas businesses was the founding of Petro-Canada, a federal Crown corporation, in early 1976.

Canada's private-public squabbling over energy control so far has sounded only a relatively minor note in the world history of this continuing conflict. Oddly the first government expropriation of oil producing lands from private owners occurred in that citadel of capitalism, the United States, in 1909. British government investment in the Anglo-Persian Oil Company (now the giant British Petroleum) created a quasi-government corporation in 1914, the first on record. In 1918 the successful Communist revolutionaries of Russia created a new type of government oil organization. Their effort was modelled as a wing of the central bureaucracy, not as a publicly owned imitation of a private corporation (such as Petro-Canada and British Petroleum).

Despite the fact that private ventures were efficient at finding and distributing oil (65% of all world oil has been discovered by them), government intervention slowly escalated. In 1938 Mexico expropriated all that country's reserves for its national company, Pemex, paying off the companies involved. The list of national companies is becoming ever longer. At this point practically every major participant in the world oil patch except the United States has a government-owned player in the field. The fabulous reserves of the Middle East and Venezuela have been largely appropriated by governments there. As the rulers of supplier nations tighten control over exports, politicians in consumer countries like Canada are becoming more nervous and wary. Here too leaders are moving towards more control in every phase of their own increasingly critical energy sectors.

When the Trudeau government created Petro-Can the stated goals of the new organization were to increase reserves, to increase the Canadian presence in this foreign-controlled industry,

Canadian Petroleum Association's Fraser Allen
"Already Canada's most regulated industry."

to help the government make sensible regulations through practical experience, and to make money. Petro-Can would speed the search on the Arctic and ocean frontiers through injections of capital (in partnership with private companies) into this high risk field of investment. Also in partnership with others, it would put money into alternate energy sources such as the Syncrude tar sands plant.

In 1976 the federal Crown corporation bought about 1,000 oil and gas wells through the purchase of the Canadian properties of Atlantic Richfield. This was followed a couple of years later with an attempt to buy Husky Oil (thwarted) and the successful takeover of Pacific Petroleums. By 1979 Petro-Can produced about 7% of Canadian gas and over 3% of the country's oil, hovering between number six and seven on the chart of the top ten producers in Canada. The private sector raged at the buying spree. Petro-Can officials mildly replied that the Canadian tax payer had the right to support publicly-financed fron-

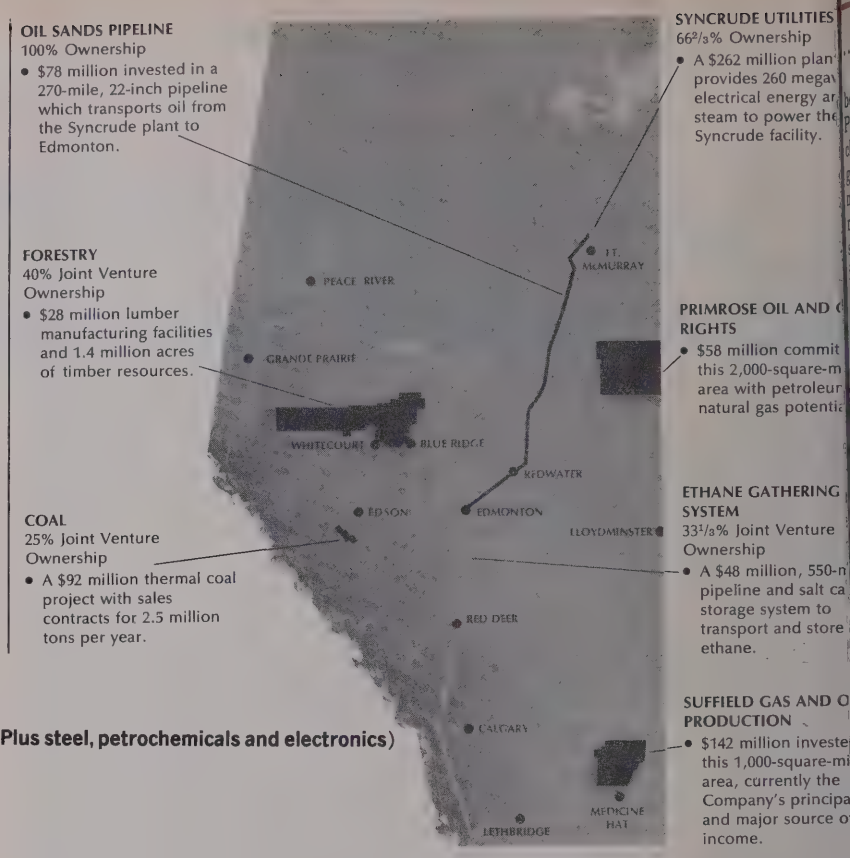
tier exploration with proven producing properties in the south.

The Alberta Energy Company, formed for much the same reason as Petro-Can, collected its share of complaints from its privately-owned competitors. The rich gas fields under the Suffield Military Block were put in their portfolio without competitive bidding. Rival companies' executives have commented bitterly that the 1,000 square mile parcel near Medicine Hat was worth ten times more than the quasi-government corporation paid. A thousand wells have since been drilled there.

Northeast Alberta's 2,000 square mile portion of the border-straddling Primrose bomb and artillery range also went to AEC. The company has interests in the Syncrude venture, coal, timber, petrochemicals, steel, electronics, and gas markets. Assets stand at a half billion dollars. Critics observe that the Alberta government is spreading its tentacles across a vast range where it isn't needed. The Lougheed regime's defense is that AEC's ten directors are all from the private sector and that half the company is owned by more than 50,000 private Canadian citizens. The Alberta government hopes the AEC will help pioneer job-creating industries such as steel and petrochemicals in a province that so far has little heavy manufacturing.

But AEC's progress has been calm compared to Petro-Can's. The federal company has the additional stigma in western eyes of being a directly-owned prong of the national government operating in the resource arena. Natural resources are a jurisdiction Canadian constitutional law mandates to provincial governments. Western regimes are inclined to see Petro-Can as possibly one more attempt by the feds to usurp influence where they don't belong. The provinces do control the federal outfit's operations in their own areas through the general regulations placed on all players in the energy industry.

It's next to impossible to find a senior petroleum executive in the private sector who endorses most of Petro-Can's policies. Since any company may at any time find itself in partnership on some venture or other with these government newcomers, however, there isn't any great enthusiasm for continuing to rip into them year after year either. As one company head put it, "They're not likely to go away no matter what we say." Nevertheless two groups continue to lobby steadily against further encroachment by government in any form, the Canadian Petroleum Association (CPA) and the Independent Petroleum Association of Canada (IPAC).


OIL SANDS PIPELINE
100% Ownership
• $78 million invested in a 270-mile, 22-inch pipeline which transports oil from the Syncrude plant to Edmonton.
FORESTRY
40% Joint Venture Ownership
• $28 million lumber manufacturing facilities and 1.4 million acres of timber resources.
COAL
25% Joint Venture Ownership
• A $92 million thermal coal project with sales contracts for 2.5 million tons per year.
(Plus steel, petrochemicals and electronics)
SYNCRUDE UTILITIES
66⅔% Ownership
• A $262 million plant provides 260 megaw electrical energy ar steam to power the Syncrude facility.
PRIMROSE OIL AND G RIGHTS
• $58 million commit this 2,000-square-m area with petroleur natural gas potentia
ETHANE GATHERING SYSTEM
33⅓% Joint Venture Ownership
• A $48 million, 550-m pipeline and salt ca storage system to transport and store ethane.
SUFFIELD GAS AND O PRODUCTION
• $142 million investe this 1,000-square-mi area, currently the Company's principa and major source o income.
PEACE RIVER
GRANDE PRAIRIE
WHITECOURT
BLUE RIDGE
REDWATER
EDSON
EDMONTON
LLOYDMINSTER
RED DEER
CALGARY
MEDICINE HAT
LETHBRIDGE

Alberta Energy Company's varied holdings
The beginning of a giant state-financed leviathan?

The Canadian Petroleum's original parent group formed 52 years ago, designed to foster communication within the industry and to the public at large. The Independent Petroleum Association split off from the CPA during a controversy over national oil policy that came to a head in the late Fifties. The CPA represents all the major international companies involved in producing, refining, and distributing petroleum products. Some smaller producers believed the CPA did not push hard enough for the sale of western crude in eastern Canada. These dissenting corporations believed the CPA leaders were just as happy to see oil imported from abroad where their parent corporations held reserves. So IPAC formed to press the cause of western oil, supported mainly by western producing companies with no refining or distribution operations.

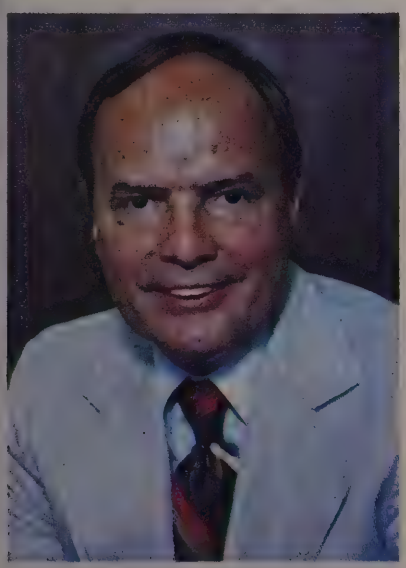
However that particular issue is now dead; eastern Canada is now demanding western oil and gas (at prices cheaper than the world rate.) IPAC and CPA see eye to eye on many issues and some companies belong to both groups. One item their views particularly agree on is the necessity to keep government bureaucrats from stifling the ongoing search for energy. Both associations view Petro-Can as potentially a sprawling octopus whose power could be increased till the private sector had no room left to manoeuver. And short of that, as good free enterprise advocates, both oil associations are inclined to believe that whatever Petro-can does, their members could do more efficiently at less cost to the public purse.

Fraser Hall Allen, 61 year old president of Amoco Canada, is current chairman of the CPA board. John Porter, IPAC's manager director, is a 50 year old commerce graduate. His 24 year career in oil and gas has involved personnel and financial work for both a major oil company and two industry associations. As far as Petro-Can is concerned, each of these private sector executives might have cloned his opinions from the other. About the only thing they approve of thus far is the ten million dollar research institute the federal company is building. All oil men want answers to the challenges posed by frontier and oil sands energy development.

There the approval ends. Mr. Porter begins, "In spite of the formation of Petro-Canada, frontier activity has declined. We saw in 1976 the federal government stating the national needed new sources of energy and a doubling of northern exploration. Their policies since 1976 have resulted in a slowdown instead. Is this the sort of practical policy-making Petro-Can's experience leads them towards?" Mr. Allen adds, "We are an industry more closely regulated than a public utility like Calgary Power. When we breathe, Ottawa writes it down. Why do they also need an energy company as well?"

Both agree ownership of Canadian resources is an issue the politicians have succeeded in oversimplifying in the public mind. According to Mr. Porter, "There are over 300 laws and more than a hundred official bodies and boards supervising the operation of the Canadian oil and gas industry. No matter who owns the companies, the Canadian interest is adequately protected." Or, as Fraser Allen phrases it, "How much money we make, how much money Canadians get, is decided by the officials who tax and regulate what we do. There's no question who has ultimate control over the resource."

IPAC and CPA members are particularly resentful of special privileges granted Petro-Can on federal lands (the Territories and offshore). The worst in their opinion is the "back-in" provision. This clause allows Petro-Can to take up to 25% of any exploration rights lease up for renewal unless commercial discoveries of oil and gas have already been made on that piece of land. A company 35% or more Canadian owned is not subject to this re-leasing condition.



John Porter, IPAC spokesman
"OK, but no cheating."

What the private companies fear is that if exploration prospects are bright in an area, Petro-Can's scouts will find out and the Crown corporation will come along for a relatively inexpensive but profitable ride. Despite strong assurance from the government, a second concern is the possibility of information leaking from government branches that collect industry data to the government's oil company.

Another shot from Amoco's Fraser: will Petro-Can be side-tracked into expensive but economically wasteful paths for political reasons? He notes that Petro-Can initiated continued drilling off the Nova Scotia coast after the companies who pioneered the area were satisfied no major finds were likely there. He and Mr. Porter believe frontier exploration would be better speeded by more lenient tax concessions and by the feds finally producing a set of regulations governing activity in that area, an action now promised for years.

Petro-Can, treated as a sort of social misfit by many of its peers in the oil patch, requires defenders with thick skins. Not only must they endure the gibes from a community deeply steeped in the free enterprise creed but they must smile reassuringly and woo for acceptance. It's not easy to convince capitalists that this government company sincerely intends to supplement rather than supplant the private sector. Reassurances that Pacific is the last big buy are greeted with skepticism. As one oilman put it, "I've never seen a government oil operation that got smaller."

Petro-Can's president, Wilbert Hopper, is a peppery, blonde-haired man with much experience in oil, both corporate and as a senior analyst with one of the world's best known consulting companies, Arthur D. Little. His round face has appeared on platforms coast to coast, convincing folks his outfit has something for everyone. A typical opinion (later imitated by the prime minister) is that the West's complaints concerning economic growth being distorted towards central Canada are out of date. Then in the east he'll advise business leaders to accept the reality that more decision-making power has already migrated west and must continue to do so. Neither audience is thrilled with his ideas. People who try to straddle widening gaps sometimes find their legs in a most uncomfortable position. But Bill Hopper soldiers on cheerfully.

Over 95% of Petro-Can's employees were recruited in the west, the only

Prime Minister Joe Clark
"Petro-Can must be dismantled." But will he?

significant pool of oil production talent available in Canada. One exception is the company's senior vice-president for finance and planning, Joel Bell. A former Montrealer, Mr. Bell's background is as a consultant in law and economics, particularly to government. The point he drives at relentlessly: "Industry asked the government to invest in energy. The PanArctic consortium came to Pearson for help, the Syncrude venture gladly took our investment, and there's going to be a lot more of this sort of request." Estimates of the investment required in Canadian energy over the next few decades run up to $200 billion.

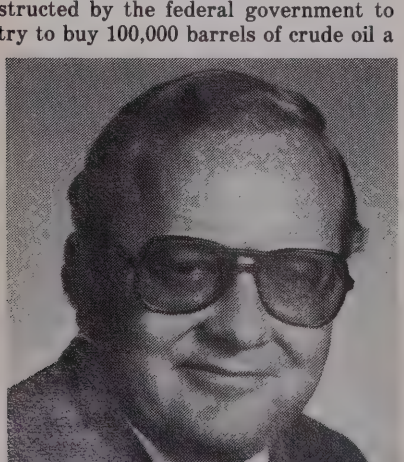
Mr. Bell believes industry needs government and vice versa. "They can't complain that we're all bureaucrats and then complain when we start a real oil company. The only way we can develop really pragmatic expertise is to run our own operation. I don't call being Canada's number six or seven dominating the industry; I know in future we ourselves would oppose an attempt to stifle the private sector. A monolithic decision making pattern in this industry would be much less effective than a lot of people all trying the best ideas they know."

He comments that his billion dollar outfit is only a fraction of the government investment in energy. "The tax structure now works in a way that means every dollar spent by a private company on frontier exploration is in fact only a risk of seven cents or so. The rest, if lost, can be written off through taxes." This is in effect a government investment in exploration through the private sector amounting to many hundreds of millions of dollars.

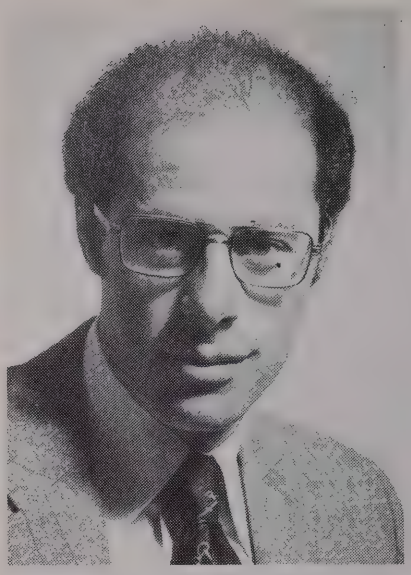
In addition Petro-Can normally allies with private partners on its ventures, partly to ensure that other judges consider each new risk a realistic gamble. The Crown corporation has negotiated offshore exploration rights with Norway, a country that refused to deal with smaller Canadian companies. As well Petro-Can insists Canada get first crack at buying a portion of any discoveries in their sector, something private companies won't do. In future Petro-Can would like to lead consortia of Canadian companies into foreign fields, the only way many smaller outfits could enter these plays. According to president Bill Hopper, the Nova Scotia venture is unlikely to produce the "elephant" finds purely profit-seeking companies naturally seek, "But prospects for smaller discoveries, very significant to the Maritimes and still profitable, are good enough that we attracted private partners." Off Labrador Petro-Can had a share in drilling that made a find (which may or may not prove to be commercial). In the Arctic islands its money was invested in 27 of the 30 wells that did get drilled in 1978.

If the company has not made major finds in its few years of existence, neither have the majors in that period with the exception of Chevron in Alberta's West Pembina. As for their resented back-in privileges on re-leased federal lands, Joel Bell says Petro-Can management knows the company doesn't need it. "This is a federal decision to encourage Canadian participation in new finds. The matter is now under review in Ottawa."

A particularly virulent controversy ensued when Petro-Canada was instructed by the federal government to try to buy 100,000 barrels of crude oil a



Petro-Can President Bill Hopper
Something for everyone.



Petro-Can Vice-President Joel Bell
Government bucks mean government presence.

day from Venezuela. The move was triggered by a dispute with Imperial Oil over how much ration Canada was receiving during a temporary shortage. Immediately the majors were worried this might be the first step towards Petro-Canada becoming import agents for all Canada's oil supplies.

Their criticisms included the charge that Petro-Can could not develop a large variety of suppliers because they woudn't be purchasing on the same scale as an Exxon-type multi-national. If then a source supplying a major share of Canada's oil imports stopped doing so, havoc might result from inability to find another source immediately in an oil-short world. Besides most oilmen believe government by nature tends to foul up. As one wisecracked, "Would you want the people who handle the mail to try bringing your heating fuel and gasoline?"

Petro-Canada executives once more attempt to soothe fears of a large scale takeover of the import sector of the industry. Says Joel Bell, "The Imperial incident was really just a ripple." But a principle is involved. "Whether we like it or not, government-to-government buying contracts are becoming more common. France, China, Mexico, Sweden and others are involved. If this becomes very common there will be less oil available to the major internationals. Their ability to build large pools from various sources will shrivel. So will their ability to guarantee supply to Canada. We think we should get into the game to learn the tricks and get a place at the table. But we don't want at all to take the game over altogether." He discounts worries that without a corporate intervening buffer, nation-to-nation bargaining spats could on occasion become serious political rifts.

In the growing controvery between public and private handling of energy one of the relatively few figures whose objectivity is respected is an Oklahoma consultant named Arthur Meyerhoff. This 50 year old petroleum geologist has worked for Pemex, Petrobras (Brazil's national company) and the Soviet oil authority as well as many others, including private companies and Petro-Can. His answers are less pat and certain than many others but he does endorse some facts and opinions.

Mr. Meyerhoff claims that unrestrained public ownership or private ownership leads, for different reasons, to wasteful practice. In the Soviet Union all energy affairs are of course government-run. Technology is backward and bureaucratic interference with efficient production is severe. However, he adds, countries lacking in private capital and technology (eg. Brazil and Mexico) may have little choice other than a national company if they want to get the most from their own resources. Even here he believes that if some competition from others is allowed, the results will include more efficiency.

He tends to disfavor government companies set up as and competing with private corporations. Mr. Meyerhoff quotes a 1975 study proving even these genuinely competing organizations on average employ almost twice as much management to sell the same amount of product as a typical private competitor. Also they tend to be unimaginative in the search for more energy, followers not leaders. This American specialist recommends that as a rule government should confine itself to regulating a privately owned industry.

However he's not sure in Canada's case. For one thing Petro-Can does seek private partnership in their ventures, a practice that helps ensure their own money is being spent wisely. For another, "They've managed to hire one of the better teams around today though it's too soon to see how well they'll do." Art Meyerhoff, who has something of a reputation for speaking the unvarnished truth, believes Petro-Can could turn out a valuable asset but only on two conditions. The management must be sound. And above all the federal government must resist the urge to expand Petro-Can's role so much that private enterprise is unable to compete. Monopoly is inefficient.

THE TOOLPUSH

Bossing the rigs.

By the antiseptic standards of modern Canada, a roughneck leads a tough life. Actually the men who worked the trade a generation back would consider their modern successors' lot a pretty soft touch compared to theirs. Even so, the roughneck today does a physical, dirty, and dangerous job. The way of life that takes him to the frontiers of Canada and the world also can lead him to both divorce and drink. More often than not he works exposed to the elements, from the broiling desert sun to the lung searing Arctic cold. If he's tough enough to last through it all and learn (some might say stubborn enough), one day he'll likely be a toolpush.

For many a young Albertan his first summer job on a drilling rig turns into a modern sort of manhood rite. And no youngster tossed from his secure childhood home into the clanking, yelling, sweating world of the rigs ever forgets his first toolpush. As the neophyte strives to make the grade, this authority figure stamps himself in his maturing mind for life. Though the experience will not likely be entirely pleasant, most young men return to civilization with their education a little more complete.

No toolpush thinks, drinks or swears exactly like another. But good ones tend to have certain things in common. For one thing they usually stand slightly apart from their men, friendly but a little aloof. Otherwise a casual pub session can get ugly when previous differences of opinion over who did what wrong are recalled. It's hard to give orders to an equal so the "push" stands on his own, unequal — the boss of the drilling crew.

Not only is he normally a fairly rugged fellow mentally and physically, he knows his rig. Asleep at night, he'll awake if certain rumblings and thumpings or the lack of them tell him something's wrong. When the rig's being torn down, trucked possibly ten miles or a thousand, then set up, his eyes are everywhere they're needed, his brain has a hundred details temporarily catalogued. If he's truly a top dog who knows all the tricks, he can sense what's happening down that hole as if by telepathy. It's not his concern if his men like him, though most do; what he demands is respect.

It's a high standard to live up to. Most succeed most of the time though there are failures, particularly when intense exploration activity means experienced men are in short supply. Who is the best Canadian toolpush no one could possibly say. But who is the most famous is much easier. His name is Vern Hunter. He's 72 years old and he pushed tools on Leduc Number One, the legendary well that ushered in the modern era of Canadian oil.

Leduc Number One
Breakthrough at last.

The Leduc well has become so covered in glory that it tends to obscure the very lively oil and gas plays that preceded it, the plays that Mr. Hunter cut his teeth on. Actually he got started in the industry as a young clerk working for Imperial Oil's production arm, the old Northwest Company. Clerking perhaps befitted the son of an itinerant rural Baptist preacher who raised his family in a series of small southern Alberta towns. But the father had guts enough to go into a bar of rowdy coal miners to preach the evils of demon booze. When he got tossed out literally before the wondering eyes of his small son outside, he had what it took to go back in for more. The courage of this breeding passed to the son, turning him towards a more adventurous life than pushing paper.

Vernon Harper Hunter was 16 when Northwest hired him as their eighth Alberta employee in August, 1923. He was paid $40 a month in a time when $150 was a really good monthly wage. Fortunately for his chafing desires, three years later he got a crack at going into the field. He was appointed clerk-truckdriver to a rig working west of High River in southern Alberta.

His toolpush was a big, tough Pennsylvania Dutchman trained in the heyday of North America's first major oil boom in the fields of western Pennsylvania. Many of the early drillers in Alberta had a similar background. This character wasn't always 100% satisfied with his new green hand. Mr. Hunter still recalls one remark. "He said the two dumbest roughnecks in the oil patch were working on his rig and both of them were me." He laughs. "What hurt was it was true." But life was pretty good nevertheless. The food was fine, especially if you liked sauerkraut, which seemed to be the main staple in the Pennsylvania Dutch diet. (Mr. Hunter did not endear himself to them when he once remarked that he'd prefer cow pies. But his toolpush con-

tented himself with retorting that taste depended on what a person was brought up on.) The engine had a steam box where the firemen cleaned the grease and mud out of the men's denim overalls after each shift.

This drilling crew was operating a cable tool rig, the original type of rig to come to Alberta. The drilling bit was a monster, a chisel-ended hunk of steel as much as two feet in diameter. The wooden derrick housed a steam-engine powered cable lifting system. The bit and the heavy drill stem, with a combined weight of tons, were lifted and dropped, lifted and dropped, chopping into the rock a little further each time. Though slow, the set up worked adequately in the soft prairie rock structures. Mr. Hunter's jobs included helping reforge the used bits, a regular chore, as well as keeping payroll times and delivering supplies.

This site turned out a dry hole though it was in an area at the south tip of the now famous Turner Valley field, Alberta's first. Vern Hunter, though slightly shaken at first by the foul language, got to liking the work and began picking up the essentials of roughnecking. When he heard of a job opening for a roughneck on a rig a few miles further north, he applied and got it. His elation was severely tempered by the knowledge that the position opened because his predecessor, one of his personal friends, got killed.

This rig was an early rotary model, still steam powered with a wooden derrick, but the bit and the drillstring revolved to dig downwards, as on modern rigs. Shifts were eight hours a day rather than the normal 12 and the pay was a stupendous $125.00/mo. & board. But all was not roses.

The field at Turner Valley is contaminated with hydrogen sulphide gas, sour smelling and deadly poisonous. Early hands, with nicknames like Snookie, Ginty, High Pockets and Hinky Dink, learned a home-made safety system. A man took shallow breaths when he sniffed poisonous gas, rushing off for fresh air when his knees went weak. It was important not to stay long enough for the sense of smell to get numbed, too, because unaware the worker might take a deep breath of poison. More than a few men were hauled off unconsious, sometimes too late.

In 1931 the Depression killed practically all activity in Turner Valley. For three long, weary years Mr. Hunter and his colleagues chopped wood and dug ditches, doing anything to stay alive. "After that, when things got going again, it was a pleasure to work seven days a week." By good fortune a friend was appointed toolpush on one of the first rigs to get started again. Vern Hunter got hired as a driller (title of a rig's shift boss) at $10 a day. Shortly after, new discoveries created a boom in Turner Valley again, spawning Litt Chicago & Little New York. But th time when the American workers r turned, the Canadians could match the skill.

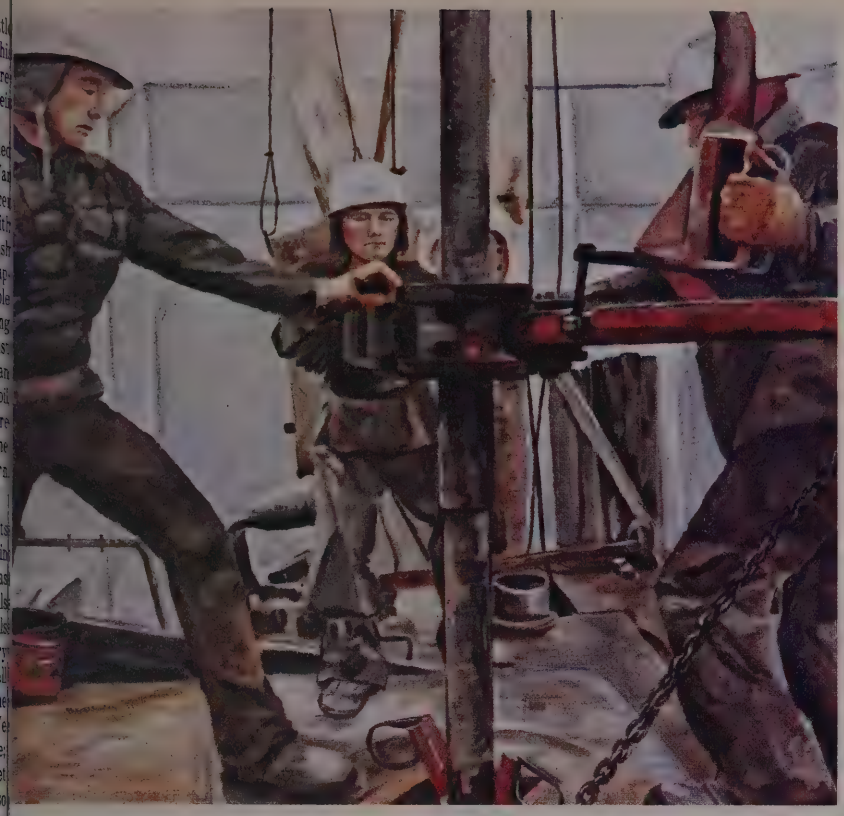
Mr. Hunter tried to join the arme forces when the Second World Wa broke out. But a senior army office convinced him his duty was to stick wit the vital industry he was now a toolpus in. For the next couple of years he cap tained one of the country's first portabl diesel-powered, steel derricked drillin rigs. In 1942 he agreed to go up jus south of the Arctic Circle to Norma Wells. "The Yanks wanted to pipe o from that field to Whitehorse. They wer worried a Japanese attack might cut th north's communications to souther sources of energy."

The Canol project was massive for it time considering the empty, wild terrai it had to cross. Mr. Hunter's job wa overall supervision of drilling new well to supply the pipeline. Half dozen well from cable tool days and a small refiner were already there, supplying smal quantities to the northern market. "Th first year was one long confusion. W practically lived on macaroni and cheese everyone was constipated. Men ge awful bitchy after three weeks or s without women." He ordered parts ove and over with no success, only to find every order arrived in multiple quanti ties when a supply barge finally made it After a couple of years, when replace ment personnel became available and lif had become relatively easy, even the princely $500 a month wages couldn' woo him into staying.

Once south again, he wandered the prairie pushing tools on Imperial rigs His only break in a long series of dry holes was the first major underground potash discovery near Wilcox, Saskat chewan. Though so deep it still awaits exploitation, the deposit triggered inter est since potash is used in explosives the potash industry has since become a vital element of the Saskatchewan econ omy, the product being used in ferti lizer manufacturing. In the woodlands o the Rockies' foothills they struck natura gas but as yet there was no market for it

By late 1946 Imperial had drilled 133 wells without one significant oil find. The only results they had to show were a Norman Wells, too small and too fa north to matter. Finally they gave up The company decided to build a plant a Leduc to convert the natural gas they had found into a fuel suitable for cars and trucks. Though expensive it was prefer able to nothing. One of the reasons they chose Leduc: there was an interesting geological structure nearby that might well contain more natural gas to supply the new plant.

Vernon Hunter, rig boss of Leduc One
Canada's best-known toolpush.



Artist: Mavis Baker

Rig crew at work
Still exhausting, dirty, sometimes dangerous.

Drilling commenced. The fate that manipulated Mr. Hunter into being toolpush to the rig was decreeing that later he would be the subject of a lot of attention as a man who made and watched history happen. At the beginning of February, 1947, in the middle of the night, the drill entered a stratum of porous limestone. The site geologist collecting rock chips from the new well found something that seemed after all those years almost too good to be true — traces of oil. Quickly a core sample was taken. Over the next ten days the small flares that result from the successful drill stem testing flamed several times. On Feb. 13 with all sorts of top brass in attendance Leduc Number One was brought in, along with a new era.

Recalls Vern Hunter, "At the time everyone was very pleased of course but, you know, we didn't know what it meant. No one then could foresee this was the beginning of a series of major finds." In fact as far as the international oil world was concerned the Leduc field looked like small potatoes. That didn't change till Atlantic Three blew out one year later. When Imperial was called in to help control this wild well, Mr. Hunter once more was involved.

Atlantic Oils was a small company owned by the man who went on to found Pacific Petroleum. Atlantic Three, their third well, struck a very porous and permeable Devonian reef saturated in oil. When the well bore tapped into it, the oil flooded up. The derrick remained standing amid a gushing fountain of oil while gas bubbled through it and columned up into the sky. For several weeks workers stuffed sawdust, feathers, and bulk materials down the drillstring pipe to block the flow. After preliminary attempts failed to stem the blowout, Alberta government officials asked Imperial to take it in hand.

Mr. Hunter at that point was Imperial's field superintendent for the Leduc field. His role in the crisis was to collect the oil and help the troubleshooters Tip Moroney and Charles Visser sent from Calgary who were dealing directly with the well. Two holes were begun, one 600 feet south of Atlantic Three, one 600 feet west of it. Both were bored slanting to the base of the wild well. In the meantime Mr. Hunter's crews dug ditches and pits to collect the crude. Trucks and later a small pipeline carried it to the railroad at nearby Nisku. From the it went to refineries in Calgary and Regina. The rest of the Leduc field was shut down for six months while the million barrels of crude thus supplied was absorbed by the market.

While Atlantic Three thrust up to 14,000 barrels a day onto the surrounding farm land, the west side relief well reached the formation that was supplying the crude. Pumps using water from the nearby North Saskatchewan River began flooding equally large amounts of water into that formation. The gusher was soon producing oil diluted with water. The water, shrouding the derrick in a haze of droplets on the surface, ate away at the shale-lined hole of Atlantic Three underground. After several days of flooding, spontaneous combustion ignited the oil and gas. A huge column of flame and smoke shot skywards, a picture carried by the world's daily newspapers on many a front page. Alberta oil was on the map.

Meanwhile flooding continued. After three days the flames slowly died, drowned. The derrick was swallowed by the well when the water-weakened shale collapsed inwards. Skill and good luck enabled the south relief well to strike the bore of Atlantic Three near the base. A grab bag of rubber matting, golf balls, gunnery sacks, wrapped in wire mesh and more was thrust down the new shaft. Finally cement was pumped in at high pressure to seal off the well called Atlantic Three once and for all. In more ways than one, a good job had been done.

Mr. Hunter remembers one moment of grim humor illustrating the danger of carelessness in the oil patch. The contract crews had strict orders not to smoke as stray gas hung about the area. One man did not resist the nicotine craving however and went to an outhouse to sneak a cigarette. When he tossed the match down the malodorous hole, gas collected there ignited. "That fellow was blown right out of that outhouse, along with the roof and the door," chuckles Hunter. "He wasn't hurt but took off across the field like a hobbled horse and we never saw him again." The site of where the wild well flooded the prairie is now indistinguishable from the surrounding grain fields.

Vernon Hunter went on to become Division Manager of Imperial, taking charge of plays like Judy Creek and Rainbow Lake. Later he retired but disliked the inactivity. So he started a consulting company that handled drilling arrangements for companies wanting to explore the Arctic Islands. Now, at 72, he's finished working once more. Perhaps now this slim, amiable man can handle retirement since he's discovered something almost as fascinating as the hunt for oil. He's turned his determination to that very suburban sport, golfing. He reports success in his new endeavor very comparable to that of pre-1947.

STIMULATION

Increasing oil flow through rock to well shaft — a vital technology.

Ideally oil or gas would trickle naturally through the tiny spaces between the grains or rock to a well bore of its own accord. In fact most of it virtually never does. When the shaft first goes down, flow may be good but gradually the pressure of oil or gas decreases; as much as 90% or even more of the energy resource may still be locked in the rock. The industry has developed many means of encouraging stronger flow. Without them some of Alberta's largest reserves of both oil and gas would be completely out of reach and the yield from all fields would be cut dramatically. The two most common methods of well stimulation are called acidizing and hydraulic fracturing.

Hydraulic fracturing, usually called fracing, first began in Canada back in 1952. But acidizing had begun early and that's how young Harry Edward Ripley got into the business. Not that any of it meant much to him back in 1952, the year he happened to get hired to work the truck-mounted acid pumps. Son of an Alberta coal miner, it just looked like a pretty good job for a 21 year old. He travelled about the province learning the ins and outs of acidizing.

The old basic method is still in use. A strong concentration of hydrochloric acid is pumped into the hole. The steel casing that lines the hole has been pierced with many bullet-sized perforations at the level of the well that reservoir engineers know will produce. Special "packers" seal the well shaft both below and, if necessary, above the production zone so the acid will be trapped there.

Mixed with agents such as anti-corrosives, the acid flows through the perforations into the rock surrounding the hole. As it leaches its way outwards, it eats crevices that gas or oil can subsequently flow down to the well. A later refinement was putting the acid under sealed pressure down the hole so the rock would actually crack, allowing the acid deeper penetration. Acid volumes range from 250 to 75,000 gallons under pressures from 0 to 12,000 pounds per square inch. On its own the acid generally travels but a few feet from the well bore before being spent but pressure can increase that to 300 feet.

One limitation of acidizing is it only works on acid-soluble rock such as the carbonates of the Leduc field; the sandstone reservoirs that contain much of Canada's reserves it won't affect. By coincidence, Canadians in 1952 were getting set to try a pioneer attempt at hydraulic fracturing. Developed in the United States by Amoco, the initial Canadian test would be done in the small Manitoba field by Mr. Ripley's new employer, Halliburton Services.

As an international company supplying services to drilling and producing operations, Halliburton even then had an expensive array of mobile equipment. In the winter of 1952 a fleet was dispatched to Manitoba across the bleak winter prairie. The trucks could do no more than 35 miles per hour; a few stretches of road were still gravel. Recalls Mr. Ripley, "What made the long cold trip down worse was we knew we had to come back." The 50 man crew packed into the small hotel at Virden, Manitoba. "I was in a corner room. The draughts were so strong there was a small wind between two windows, one on each wall."

This frac operation was essentially the same as its successors, though on a much smaller scale than many now are. The pump trucks that normally carried acid were filled with kerosene and a thickening agent to gel it. A thousand pounds of sand were ready. The kerosene was pumped under high pressure into the hole. When the compression was sufficient, the rock fractured and the kerosene flowed down the cracks. At the surface the crew began shovelling sand into the kerosene as more was pumped downhole. The sand also was carried into the cracks.

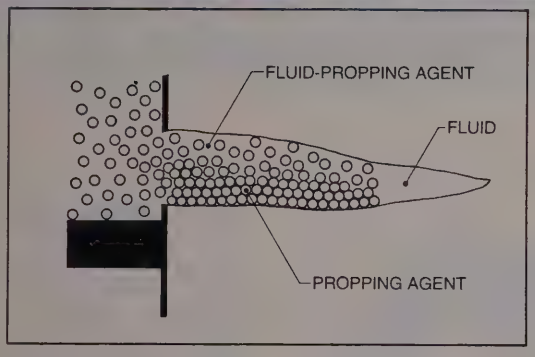
The hole was then sealed under pressure. Gradually the kerosene lost its gel, allowing the cracks in the rock to reclose. But not completely, for minute cracks were held open by the sand. In this early experiment these fractures extended possibly 20 feet from the well bore. When the well was reopened and allowed to flow, the kerosene was recovered. The new rate of oil production amply justified the expense of fracing.

Within a year the new technique was to play a crucial role in the brand new Pembina oil play. In surface area this field is North America's largest and, without fracing, Pembina would produce nothing at all. Technicians like Mr. Ripley learned the innovations as they were introduced. Glass beads and other grit (even walnut shells) were tried instead of sand. In time water-based fluids largely replaced kerosene. Fracture lengths increased to 75 feet, then to

Photo by Creative Associates

The largest frac operation in Canadian history
Enhanced recovery means more energy reserves.

Vithout fracturing some good wells would die.



TOP—Harry Ripley, from the first to the biggest
BOTTOM—How frac material moves into the earth

50 and 200. Sand quantities rose from as low as 1,000 pounds to 15,000.

In 1957 he went to the University of Alberta, earning a degree in petroleum engineering. When he returned to Halliburton, he began a series of steps up the corporate ladder that led to his present position, manager of technical and engineering services. Of the company's 500 employees in Canada, most are under his jurisdiction, scattered across the national oil patch from Fort St. John B.C. to St. John's, Newfoundland. Thus he happened to help design another first in Canadian fracing.

In partnership Texaco Exploration and Canadian Hunter held gas-bearing leases in the area of northwestern Alberta known as the Deep Basin. The gas-bearing rock, mostly impervious to acidizing, is exceptionally tight. But if it can be forced to flow, there are trillions of cubic feet of gas waiting to be tapped. The situation was ripe for massive hydraulic fracturing, again a process developed in the U.S. with Amoco taking a lead role. A team of American specialists was recruited to supplement the operating companies' expertise. Halliburton was chosen as the service company.

The man who did the basic design was Steve Holditch, a professor from Texas who is known as "the father of mass frac." His aim — to create a fracture pattern 2,000 feet long through tough rock. If it was long enough, these fractures would collect slow-moving gas and feed it to the well bore quickly enough to create a profitable well under conditions previously considered economically hopeless.

The equipment was one of the largest foam-type fracs ever attempted in North America. Mr. Holditch notes, "We used six million cubic feet of nitrogen, close to a record amount ever assembled on a drill site." Though by Canadian standards the 250,000 pounds of sand required surpassed anything earlier, in the U.S. twice that amount has been tried. For this one attempt, planning had been going on six months.

Mr. Ripley had no direct field role (though he directed some of the design done at Halliburton's Calgary headquarters). But he made sure he was present at the Elmworth mass frac anyway. "It was 31 degrees below Fahrenheit. We'd assembled an array of blenders, pumpers, combined nitrogen transport-pumpers, and all the chemicals. There were eighteen industry vehicles on the site that day." The operation took three days, culminating in a seven hour frac. Cost was over $400,000.

Everything went according to plan. The quantity of gas released was significant but did not justify the operation's cost — yet. If prices rise, as anticipated, that will change and mass frac may become a common tool of the trade in the Alberta foothills.

The range of research and experimentation in the oil and gas industry is greater now than ever before. All agree the days of cheap energy are past. Increasingly worried governments and corporations are emphasizing the need to find more and to exploit what is already available more and more efficiently. At age 48 Mr. Ripley has already seen great progress. One item he's now working with is a new polymer material for helping prevent water from mixing in with oil in the underground reservoirs.

Many wells are ruined by water. As the energy resource is depleted, an area of lower pressure is created. Long before all the oil is gone, water may gravitate into the low pressure area, diluting the oil to such an extent that the well becomes uneconomical. The polymer material Mr. Ripley is now trying to use and adapt to Canadian conditions reacts differently to oil and water. When injected into the ground, it coats the rock and sand grains with a film just one molecule thick. When oil passes by, the shape of that molecule flattens, allowing the resource passage.

But when water tries to pass, the molecule's shape ridges out to block the space between the grains. In some situations where one gallon of oil is coming up diluted with 100 gallons of water, the polymer material can reduce the amount of water to 25 gallons. That in turn sometimes allows an increase in oil flow, further reducing the dilution ratio. Things have changed a lot since they just let the well flow till it stopped, just one generation ago.

Two Canmar drillships on duty

Mach 2

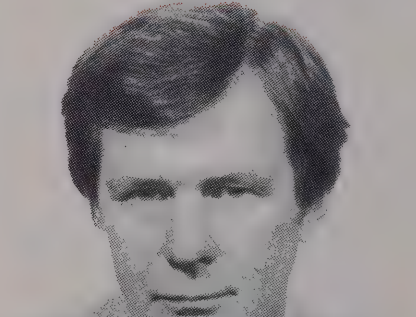
Elephants in the Beaufort Sea

Dome's bold leap offshore.

The floor of the Beaufort Sea slopes gradually down from the Arctic coast to a depth of 300 feet, then plunges steeply. Below the shallow portion lies a 150,000 square mile geological basin, an extension of the Western Sedimentary Basin. Drilling from its artificial islands close to shore, Imperial has made rich gas finds. But continuing exploration indicates that the real grand prize, the elephant discoveries, may well lie further out. It was a Canadian company that took the plunge into the deeper Beaufort, risking hundreds of millions and carrying Canada to world leadership in cold water drilling technology.

That company, Dome Petroleum, has drilled into five of forty potential energy-bearing formations, identified by 27,000 miles of seismic probes. All five of the giant Beaufort structures contained hydrocarbons. Flow tests measuring just how much oil and gas is there were prevented by the brevity of the maximum 90 day drilling season. By 1980 Canada will know if, as optimists hope, Dome has found reserves equalling all Canada's known oil supply. In anticipation Dome Pete's share price rose from $40 to $100 in a year and could double again if their Arctic gambling pays off.

Now the flag ship of the Canadian-owned oil producers, the company began humbly enough in 1948. Founded with



Gordon Harrison
"I might've turned tail..."

capitalization of a quarter million dollars plus 7.5 million in debts, Dome's assets today tote up over $2 billion, its employee roster at 1,500. The 63 year old Calgarian who has piloted the company's course for thirty years, John (Smiling Jack) Gallagher, has a well-known genius for persuading others, including the guardian of the federal purse, to finance his gambling. A prime ingredient in the persuasion is his industry-topping record of success in playing geological hunches in southern Canada plus building profitably placed gas plants and pipelines. Not least, he attracts talent.

Gordon Harrison he recruited over breakfast in the spring of 1974 in a posh London hotel. The Dome founder was searching for someone to boss Canadian Marine Drilling (Canmar), a subsidiary newly formed to carry out Dome's Arctic undertakings. The 49 year old Mr. Harrison carefully surveyed the challenge. There was a consensus of opinion in the Calgary oil community that this time Smiling Jack had gone off the deep end professionaly as well as literally. Bluntly, the experts mostly believed it was unlikely the frigid Beaufort masked the mammoth reserves needed to justify the immense cost and challenge of drilling along the edge of the polar pack ice. Plus the man responsible for any mishap to what frail life forms survived in that brutal ecology would be branded an incompetent ogre . . . in shrieking headlines.

Gordon Harrison took the job. Difficult tasks, he remarks, can provide a certain satisfaction if done well. Raised and educated in British Columbia, his career could have been tailor-made for the Beaufort. The lanky engineeer had risen to the superintendency of Canadian exploration and production for Mobil, a major multinational. After drilling 200 miles off Nova Scotia on Sable Island, he'd prepared Mobil's operations in the

he base at Tuktoyaktuk

tlantic itself, probing Newfoundland's rand Banks. Before that play actually olled, he went through a stint in New ork, a grooming session given potential op Mobil executives. From there he witched to their North Sea drilling perations, where he met Mr. Gallagher.

In March, 1974, Dome's Arctic project eceived a conditional go-ahead from the ederal government — subject to a host f future approvals on yet-to-be-devel-ped equipment, oil spill recovery meth-ds and other environmental considera-ions. Gordon Harrison took over a anmar staff of two, building it up to 50. Across the nation Canmar let ontracts for what has become a $250 illion fleet of three unique ice-rein-orced drillships and seven supply essels. Under the spur of soaring il prices, world offshore activity was ectic, meaning a shortage of per-onnel and equipment.

Recalls Mr. Harrison, "Fortunately we ut together a first class team but even o, if I'd foreseen what it would be like, I night have turned tail right there. here were times I didn't think we could lo it." Items like oil spill recovery echnology for use among ice floes had to e developed. Industry and government ut $25 million into environmental stud-es. According to the Canmar chief, the airiest moment may have been the epic ,000 mile voyage of the company fleet from Vancouver to the Mackenzie delta in the spring of 1976. "The boats sailed before we even knew if the government would give the necessary final ap-provals."

The wells, as deep as 16,500 feet, cost up to $35 million apiece. At the end of 1979 capital investment will total $250 million, operating costs $500 million. Once a drillship is moored in place, a ceaseless patrol of icebreakers, heli-copters and planes watches for ice drifting in from the nearby perma-nent pack. Two blowouts and the acci-dental dumping of 70,000 gallons of volatile fuel from a government ice breaker (all relatively harmless) have led the way to improvements in methods and equipment design.

Indeed, claims Mr. Harrison, their technology is working so much better than anticipated that it may in future be possible to drill all year round, meaning a tremendous cut in per well cost. If so, the oil and gas would cost Canadian consumers much less. In the spring of 1979 Dome released figures predicting that by 1990 the Beaufort could be providing 60% of Canada's current oil consumption, 70% of its present natural gas needs.

In 1978, with 650 field positions available, 180 northern residents were hired. Relations with a committee elect-ed from seven local villages have been quite cordial and are double-checked by government officials. Local Inuit have reached positions like personnel officer and yard supervisor at the Tuktoyaktuk supply base. But Gordon Harrison, in-evitably a free enterpriser, is even more pleased with a taste developing among the area's 3,500 people for the benefits of business. "Over 80 businesses in the area service our operations." Some, like the base camp's cleaning contractor (owned by a woman) are native run. Though the company watches carefully for the in-evitable problems, hunting and trapping is actually up while some Inuit appear to be undertaking permanent industry-type careers. So far two ways of life have meshed.

Dome now holds 22.3% of TransCana-da Pipelines, making it the largest shareholder in the company that led the Arctic Gas coalition wanting a pipeline down the Mackenzie valley. Though Dome plans to ship its Beaufort pro-duction initially by tanker, the company talks confidently of building the Macken-zie line after all. That in turn could lead Dome into open conflict with the pro-moter of the rival Alaska Highway route, Robert Blair's Alberta Gas Trunk Lines. A showdown between Alberta's energy czars Smiling Jack and Battling Bob, whether it resulted in compromise or flying fur, would indeed be energetic.

July, 1789. The 25 year old Scot staring over the Frozen Ocean had travelled 5,000 miles across a rugged continent in frail canoes searching for a route to the fabled riches of Asia. Now he knew he had failed. The 1,700 mile river his small party had just descended only led to this empty polar sea. Today that stream bears the young explorer's name, Mackenzie. He himself called it the River of Disappointment. Two centuries later that title would prove prophetic.

In the meantime more white men came, first as fur traders and missionaries, later as prospectors, doctors, bargemen, teachers and eventually civil servants. The tribes ceased warring and took up commercial trapping. But slowly animal populations dwindled, while the natives' numbers rose beyond what the land had ever supported even in good seasons. Modern medicine joined with the modern welfare system to ensure disease and starvation were controlled. For many youngsters hunting and trapping became a thing of the past. But wages were scarce. Alcohol was not. By the Sixties the Indians and Inuit of the Mackenzie were floundering to find some purpose in the strange world slowly enveloping them.

The socio-economics of the North was not the specialty of Calvin Ralph Evans when he arrived at the river's mouth in 1964. The year before he'd hired on with Imperial Oil, shortly after receiving a doctorate in isotope geology from Oxford. Now he was examining gas seeps in the Mackenzie delta flatlands, putting his geochemist's skills to work figuring out if the area was worth more expensive types of investigation. The seeps, invisible in summer, could be spotted in winter from the air since the warm gas kept the ice and snow cover melted. So that spring found Dr. Evans happily snowshoeing about the area, using home-made machinery to collect samples from the seeps to bring south.

At that point he couldn't be aware that he would a decade later be heading a massive Mackenzie play for Imperial, striving to bring to harvest the fruits of his company's most promising exploration. But even in 1964 as Imperial assembled rights to over ten million acres of the Northwest Territories and the Yukon, it was obvious this might become a major source of energy supply.

In the early Sixties Imperial had done an exhaustive study on future possibilities for finds in western Canada. At that point they had no idea the world prices for oil and gas would sky-rocket over the next fifteen years. Values in 1964 had in fact dropped since World War Two. Imperial's analysts decided it was unlikely there were major deposits of oil or gas in Alberta recoverable at the stable prices they foresaw. Therefore they decided to move to the last unexplored frontiers.

Imperial's artificial island ADGO J-27

The Majors on the Mackenzie

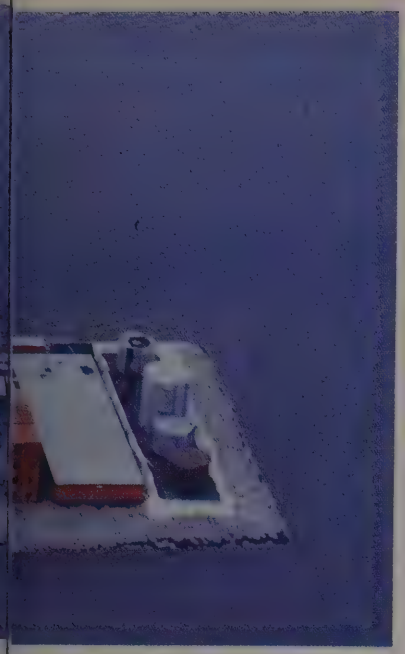
Technical triumph, political disaster for Imperial, Shell and Gulf.

Dr. Evans was to play a series of key roles in this move, winding up in charge of it. Despite his superb technical education, he and his industry would be faced with a challenge they were ill-prepared to meet. Still, being born and bred on a farm 35 miles west of Red Deer did instill a supply of tenacity in the Imperial geologist. At age 15 he had left home, working nights as an apprentice refrigeration mechanic while finishing high school during the day. He recalls, "I got interested in the earth's structures during hikes in the mountains." After earning bachelor and master degrees in geology at the University of Alberta, he went to Oxford, then Imperial.

When his company began shifting exploration to the frontiers in 1965, the major concern was amassing oil and gas reserves. Any pipeline south would require large supplies to justify its high cost. In the latter half of the Sixties Gulf and Shell accompanied Imperial into the Mackenzie area. Hundreds of millions of exploration dollars were injected into the contest that ensued.

In 1968 Dr. Evans was promoted to supervisor of the exploration services and research division. That year the northern expectations were raised dramatically by the discovery of major reserves of oil and gas on Alaska's North Slope. Imperial's Delta holdings alone now totalled ten million acres. Gulf was assembling three million more and Shell a million. Near the base camp area at Tuktoyaktuk the three pooled resources to drill exploratory wells.

By the 1969 winter season the growing Alaska discoveries were kindling hopes that the Canadian north coastal area adjacent to the rich Alaskan formations might be equally abundant with oil and gas. One in five of all Canadian geophysical crews were now operating in the region, a ratio that had doubled since 1968, itself a doubling of the previous year. In 1967 the frontier area



bsorbed 25% of Imperial's exploration udget; two years later that figure assed 60%. And finally the company hit il, 100 miles northeast of Inuvik at tkinson Point, in early 1970.

Gulf and Shell were encouraged to tep up activities in the delta, with Shell rilling its first well shortly after. The hree majors took an active role in a new yndicate, Arctic Gas, formed to build a ipeline from Prudhoe Bay, Alaska along he northern coast to the delta, then outh along the Mackenzie valley and on nto Canada and the United States.

Cal Evans, by now senior Imperial xplorationist for the play, saw it as imple common sense to hook the two ources along a single line. "If you have nore resource to ship, the pipeline costs nuch less per unit carried. Doubling ipe capacity requires a lot less than wice as much steel. And of course the ost of applications and environmental mpact studies is much less." The majors ealized there would have to be studies n social impact as well. A variety of programs to train local people were put underway. Such matters had been dealt with many times before around the world.

Mr. Evans recalls, "We hired the best environmentalists in the business and put them to work." Particular areas of concern were the effect of a pipeline on migration of caribou, on perma-frost, and on the upstream calving of Beaufort whales. Oil company naturalists considerably widened the data base available for Arctic flora and fauna, while searching for ecologically safe solutions. Drilling equipment was stockpiled on gravel-colored styrofoam pads to protect the tundra. Revegetation and the biodegradability of oil in Arctic water were researched at universities, financed by the Arctic Gas pipeline syndicate. In the end Arctic Gas spent $100 million on environmental investigation, employing up to 170 people plus a host of consultants.

By 1973 Imperial had 90% of its exploration budget at work on the frontiers. Gulf had wracked up the best record of proving reserves per dollar spent. Of 18 Mackenzie wells they'd participated in, five were good. Imperial had found ten producers at a cost of $30 million. Shell had gas reserves in one new field calculated at a trillion cubic feet, a 20% increase in the Canadian subsidiary's total. A group put together by these and other companies to study an oil pipeline eventually decided insufficient reserves of oil made the proposal uneconomical. Planning continued on a gas line.

A significant development was Imperial's island building. In 1973 Mr. Evans, now assistant manager of all his company's exploration operations, worked with his team to follow the gas bearing formations offshore, just north of the delta. Over the next five years Imperial constructed fourteen artificial islands, moving steadily into deeper water. Barging infill from shore and dredging sand from the sea bed using suction and a floating pipeline, the company found making the $10 million islands cheaper than installing offshore drilling platforms. Problems with ice were significantly reduced and the installation was permanent.

In 1974 on the second island, Adgo F-28, Imperial's drillers hit a rich field of gas with some oil. Other finds followed. The delta's total reserves are now calculated at between six and seven trillion cubic feet of gas, Imperial holding half, Gulf more than a quarter, and Shell over one seventh. By 1977 Shell had hit pay four times out of 19 tries, while Gulf had eleven wells capable of daily volumes between 9 and 35 million cubic feet a day. Total investment in Arctic exploration passed a half billion dollars, the Mackenzie onshore and offshore operations alone soaking up about two thirds the total.

In 1975 Cal Evans became explorations director for all Imperial's scattered operations. He was particularly pleased with environmental impact studies on the caribou. A herd of 120,000 roamed seasonally across the proposed pipeline's right of way along the coast. These stolid creatures were seen grazing apparently unperturbed in fields bounded by gravel roads, pipelines, compressor stations and even a sound simulator throwing out noise like a DC8 jet engine. One band of researchers found a herd streaming through its base camp. On another occasion a pilot trying to land near Coppermine could not buzz caribou off the landing strip with low-flying passes.

Professor Lawrence Bliss of the University of Alberta later chided the researchers for inadequate study of the sensitive calving period. But even this independent authority noted that, "on two occasions cows with new-born calves paid no attention to several low passes of the aircraft, even at altitudes of one or two hundred feet. On other occasions cows stayed by dead or sick calves even with helicopters nearby." Dr. Bliss believed the caribou and other Arctic flora and fauna were not threatened by the Mackenzie route as long as care was taken, a conclusion that Dr. Evans was happy to see was shared by most investigators. The perma-frost problem was solved by reducing the temperature of the flowing natural gas below freezing.

Calvin Evans
Exploring the River of Disappointment.

Traditionally the top brass of oil companies are essentially technicians, trained to cope with climates, minerals,

machinery, markets, and even animals. They do not specialize in that most unpredictable of all creatures, the human being. Early in the struggle to build the Mackenzie line the oilmen knew there could easily be trouble over the fact the valley's original claim to the area through a signed agreement with the federal government.

However men like Dr. Evans assumed the government would deal with this problem. Surely treaties weren't their responsibility. Besides, with energy prices quadrupling in less than a year, the Trudeau government had announced the Mackenzie gas reserves would be a vital element in Canada's drive to reduce economy-crippling imports from overseas.

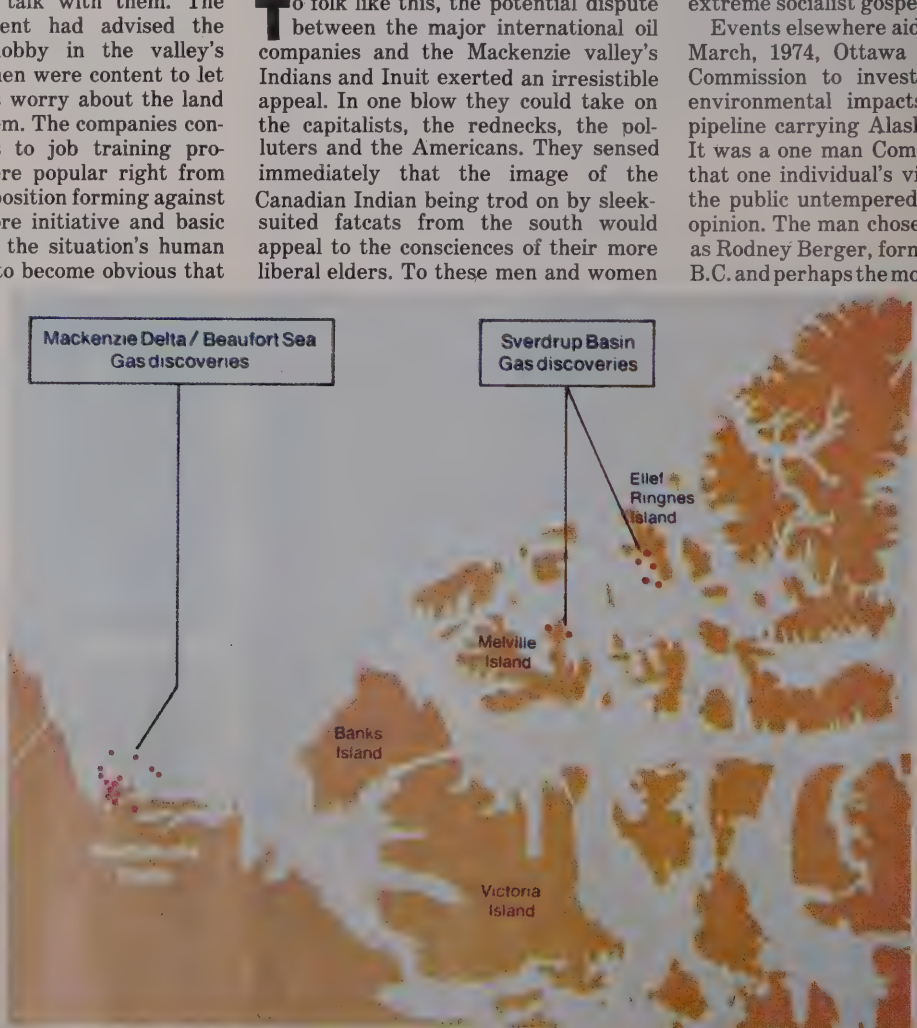
It was worrisome that some powerful native organizations in the valley practically refused to talk with them. The federal government had advised the oilmen not to lobby in the valley's villages. The oilmen were content to let the civil servants worry about the land settlement problem. The companies confined themselves to job training programs, which were popular right from the start. The opposition forming against them showed more initiative and basic understanding of the situation's human potential. It was to become obvious that oilmen understood Inuit and Indians no better than these northerners understood them.

In Canada a portion of the youth radicalized by American cultural spillover in the Sixties had never found any enemy to really sink their teeth into. No Vietnam War united their generation, no Nixon or Johnson obligingly played the role of ogre to their knight. The most potent conglomerate of such individuals, the Waffle wing of the New Democratic Party, had been expelled from the parent group for being overly radical. Centred in Toronto their focus was, somewhat contradictorily, nationalist (i.e. - anti-American) and Marxist. Its more capable members had acquired considerable experience organizing inner city groups, anti-freeway movements and the like.

To folk like this, the potential dispute between the major international oil companies and the Mackenzie valley's Indians and Inuit exerted an irresistible appeal. In one blow they could take on the capitalists, the rednecks, the polluters and the Americans. They sensed immediately that the image of the Canadian Indian being trod on by sleek-suited fatcats from the south would appeal to the consciences of their more liberal elders. To these men and women Cal Evans and his colleagues were quit literally the enemy, the stooges Yankee imperialism.

Wafflers like Peter Puxley and St phen Iveson were present in Yellow knife, centre of the Northwest Terr tories' administration, as early as 1969, year after the Alaska strike. The worked originally with young volunteer willing to spend at least one year tryin to help others, a federally financed grou called the Company of Young Canadians By the time the CYC was later dis banded by Ottawa for radical politica activities, the Yellowknife white radical had thoroughly infiltrated the India Brotherhood of the Northwest Terri tories. They had engineered a change i its leadership, wrote its officers speeches and submissions to govern ment, and were effectively spreading a extreme socialist gospel.

Events elsewhere aided their cause. I March, 1974, Ottawa created a Roya Commission to investigate social and environmental impacts of a northern pipeline carrying Alaska and delta gas It was a one man Commission, meaning that one individual's views would reach the public untempered by other officia opinion. The man chosen: Justice Thom as Rodney Berger, former NDP leader i B.C. and perhaps the most effective India



The locations of Artic gas discoveries
Gulf, Shell and Imperial are in the Mackenzie Delta area; Dome's operations are further offshore; Panarctic is the major force in the northern islands.

hts activist in Canadian history. His g legal career reflected a deep con- n for the plight of Canada's aboriginal oples. He knew little about energy. ere are many in the oil industry o suspect his appointment by the udeau regime reflected that minor- government's need of Parliamentary pport from the federal NDP to stay in wer.

The Berger hearings that began on rch 3, 1975 were the best-publicized yal Commission proceedings ever to ke place in Canada. The 42 year old dge held sessions in 37 northern mmunities and ten southern cities, llowed everywhere by a specially- signed CBC team, native communi- tors and a kaleidoscoping cloud of ner media. The drama was heightened nen the Indian Brotherhood of the rthwest Territories, now relabelled e Dene, issued a statement five nths after the hearings began calling a racially-based state to be formed in e North.

Throughout the hearings activist ele- nts from the Christian churches play- a decisive role. An umbrella group own as Project North was formed th support from the two sects most tive along the Mackenzie, the Anglican d Roman Catholic, as well as others. om this source and its allies the rger Royal Commission received ores of submissions, most deploring e situation that would develop along e proposed route if the Arctic Gas line ere approved. No road or rail artery t linked the valley to the south. The tive cultures would be swamped by nite workers, booze and prostitution, stroying forever their hunting and apping habits. Or so the Christian tivists from the south believed.

Strangely, virtually none of these urch briefs came from the Christians ho really knew the Mackenzie situation st, the missionaries who had worked ere for decades. A great many of them vored the pipeline, knowing hunting d trapping were already hopelessly sufficient as a means of support for eir flock. Besides, most parents wished life less hard and better paid for their ildren if possible. One study for the deral government done by Derek nith in 1975 showed that native stud- ts in two Arctic settlements focused eir wishes overwhelmingly on jobs like lot, radio operator and doctor. Hunter- apper placed fortieth on the list of ssibilities.

But northern churchmen also sup- ported a good land claims settlement r their flocks. Realizing the pipeline as being used as a hostage to acquire verage in the land negotiations with the federal government, none wanted to strengthen the hand of the pipeliners even though they knew the project would mean thousands of permanent jobs. At this point, one missionary recalls, most people believed the Mackenzie line would be approved despite opposition.

The northern natives themselves stayed remarkably united for the same reason. Some strays complained of the pressure on them to conform to the Dene line to Tom Berger (complaints the judge consistently did not investigate). One Loucheaux Indian, Suzie Huskey of Inuvik, protested that she could not even find out important aspects of the land claim the Dene leaders and their white advisers were pushing for. But, by and large, the Dene field workers (carrying Mao's little red book and instructed in the operating principles developed through the Tanzanian revolution) managed to convince dissenters to keep silent. Ironically their work was largely financed by over $2 million in federal government and oil company funds. Even money from Oxfam's March for Millions was granted to these advocates of a race-based state within Canada.

Justice Thomas Berger
Deciding the native's needs.

When the Berger Report came out in May, 1977, it recommended a ten year moratorium on pipeline construction in the Mackenzie valley. The Dene needed time, the judge wrote, time to be trained, time to develop the means to put their ambitions into reality. Despite the estimated $5 billion subsidy southern Canada will have to pay over the next decade to finance northern administration unless new resources are brought on stream, Mr. Berger believes the Dene could largely support themselves if traditional industries and crafts were intelligently encouraged. The evidence supporting this hypothesis was both thin and theoretical. Tom Berger went against the bulk of the on-site investigators when he concluded that a line should never be built along the west Arctic coast due to the risk of environmental damage. Critics charge he merely twisted that issue to support the vision of a racially-based society.

If so, he dealt that prospect a severe blow when he recommended in favor of an alternate route being proposed along the Alaska Highway for American Arctic gas. Westerners were pleased with the prospect that the largest construction project in their history would be handled by a western-based consortium. Alberta Gas Trunk Lines, spearheaded the Foothills group, advocates of the Alaska Highway (Alcan) route south through the Yukon into Alberta. The Arctic Gas coalition, eastern-controlled, was still anticipating the federal government would ignore the Berger Report and approve their line. But companies like Imperial quickly realized a gas line bypassing the Mackenzie valley could be built southwest from the delta along the Dempster Highway to join the Alcan route. If the Berger recommendations were followed, no pipeline would have to go down the Mackenzie. But the valley would lose many jobs and much economic development. Perhaps Justice Berger saw that as a way of nudging the natives towards his vision of their future.

In those years Cal Evans spent much of his time trying to rescue the sliding situation. The Dempster-Alcan route would be far more expensive and energy-wasteful an outlet for delta gas than the much shorter Mackenzie route. But, he recalls ruefully, "We had taken a public relations bath." Impressed by the political furor, the federal regulatory agency, the National Energy Board, quashed the Mackenzie line. The board agreed that the Alcan route would be less socially and economically harmful since the Alaska Highway already was there. The Alberta Gas Trunk Lines-led Foothills consortium had won a significant victory for the growing Calgary financial complex over rival Toronto, aided by a socialist judge. Arctic Gas had spent $250 million and lost.

In 1978 Imperial created an exploration and production subsidiary, Esso Resources, and Dr. Evans became its senior vice-president. By then Gulf, Shell and his company had reduced their Mackenzie activities to a crawl, refocusing their efforts on the south. But Imperial is still slowly building islands, now in water as deep as 90 feet, awaiting the day their billions of dollars in natural gas will be released. Perhaps Cal Evans takes heart from his predecessor, Alexander Mackenzie. Within four years of his exploration of the River of Disappointment, the tough Scot became the first overlander in Canada and the United States to reach the Pacific.

Searching for the Pinnacles

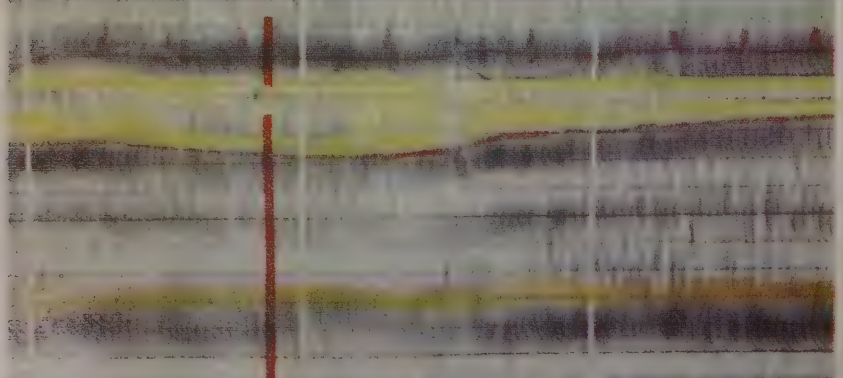
Competitors play hide-and-seek with each other and oil in Alberta's latest play.

In 1882 John Davison Rockefeller, aged 43, became a legend when he formed the Standard Oil Trust and locked a stranglehold on the mushrooming American petroleum industry. Before the United States Supreme Court forced it to split into seven unconnected organizations in 1911, the Trust's complex of companies monopolized over 95% of America's petroleum refining capacity. The founder of the Standard Oil monopoly, his country's first trust, might have felt considerable pain watching the oil play at West Pembina, 60 miles southwest of Edmonton, as it has unfolded over the last five years. For the two prime contenders among more than 60 companies competing fiercely in West Pembina are both Canadian descendents of fragments of his all-powerful brainchild.

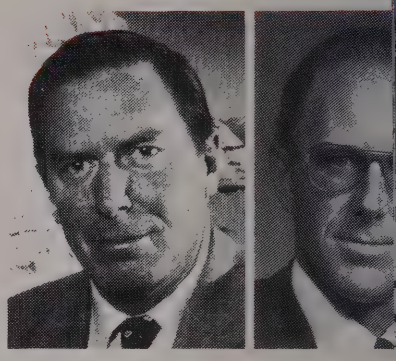
Amoco Canada, subsidiary of the old Standard Oil of Indiana, and the Chevron Standard Company, owned by Standard of California, have lengthy Canadian histories of aggressive exploration. Chevron's activities have ranged into every major area of operations in this country except the Beaufort Sea. It's crews have operated in the waters and coasts of the Pacific, Arctic and Atlantic. The small Manitoba field is dominated by this charter member of Canada's top five producers. But most of its oil and gas comes from central Alberta.

Amoco, under the name of Stanolind, was searching for Canadian crude within a year of the 1947 Leduc find. Amoco Canada will spend over $275 million in 1979 on exploration and production. The company's best early breakthrough was grabbing an early lead in the scramble for West Pembina's daddy, the Pembina field itself. Covering more than a thousand square miles and ranking as North America's largest field in the area, Pembina's reserves of 1.3 billion barrels were first discovered by Mobil (another Standard Trust component). In those days of the early Fifties, the roads around Drayton Valley, headquarters of the Pembina field, were grim muskeg traps. If a car met one of the giant trucks of an oilwell supply outfit, the car would simply drive into the ditch to let the truck by. Etiquette demanded that the truckdriver then help haul the car back on the muddy track. At one point, a Cat was permanently stationed at a particularly bad patch to haul vehicles through.

Though exploration was intense at that time throughout the Pembina area, several factors conspired to allow the deeper West Pembina reserves to escape undetected. Though the two overlap, West Pembina's production zone sits approximately 4,000 feet below Pembina's oil and gas, itself about 6,000 feet below the surface. Further, West Pembina oil is trapped in pinnacle reefs, very high and narrow, very hard to find. Pembina itself is a continuous field but West Pembina is really a scattering of many mini-fields, all isolated from each other.



Seismic graph results
The wave pattern outlines underground structures.



Chevron's Gerry Henderson (left) and Amoco's Byron Richards
An exploration chief's lot: precise detection and inspired gambling.

The tools used to find these unusual formations were the classic methods of geology and geophysics. Gerry Henderson, senior vice-president of Chevron, heads the team that did the detective work. Though Dr. Henderson's credits include 26 years with Chevron and a batch of degrees from McGill, Dublin's Trinity, Oxford and Princeton, this British Columbia-raised geologist claims, "I don't do much around here but judge other people's recommendations." He's the top end of a long chain. At the other end of it, a typical major oil producer employs field geologists who examine and test rock cuttings and core samples as the rigs they're stationed on bore into the earth. These men and women are looking for evidence of oil, gas and water in the rock the drill has reached. The other critical elements are whether the material has porosity and permeability. Porosity means space between the grains of the rock or sand for oil or gas to sit, much like air in styrofoam. But the holes must be joined so liquid or gas can flow to the well bore, defined as permeability. Samples collected by field geologists are carefully evaluated in city laboratories as well as in the field.

earing access roads to the Pembina field in 1955

part underlying the discovery of Pembina itself, West Pembina's unusual riddle took another 20 years to unlock.

nce a geologist has two to five years experience, his main job will be fice-based, evaluating land and drilling ospects. Information from other wells d older explorations is matched with w data to search out good gambles. areer geologists pass through steps med variously at different companies, typical progression being intermedie, senior and company geologist. Divion geologists have responsibility for rge land areas, reporting to the comny's vice president of explorations. As geologist progresses, his work changes om direct analysis to the supervision hers, and making the final decision tween different projects.

In 1974, while the provincial and deral governments fought over the creased royalties made possible by y-rocketing petroleum prices, most xploration across Canada and Alberta owed dramatically. But Chevron deded to gamble on the ultimate good nse of politicians and proceeded with a lanned seismic line from Saskatchewan ross Alberta to the edge of the oothills. That decision resulted in the iscovery of West Pembina.

Seismic exploration is a key tool in iscovering what lies beneath the earth's rface. The reason Chevron's seismic ork showed up those narrow pinnacle efs where exploration in the Fifties did ot is that seismic technology has adanced in the interval, the change being s dramatic as difference between a 1955 lack and white television and a 1979 olor set.

The basics haven't changed though. Iiles of cable are laid down. Attached to he cable at short intervals are geohones or "jugs," steel-encased microhones which are planted by hand firmly n the ground. The cable itself feeds into a recording computer mounted in a truck or all-terrain vehicle. In a seismic shoot, vibrations are created, either by dynamite exploding in shallowly-drilled holes or by massive motorized vibrating machines. As the shock waves travel into the earth, they pass strata made up of differing materials. Layers of shale, sand, rock, and other materials, either pure or in various combinations, sit on the earth's basic crust, the Precambian bedrock. As the shock waves reach each new layer, the change causes some waves to echo back to the surface, where they are recorded by computer graph. Thus a map of the underground formations can be drawn.

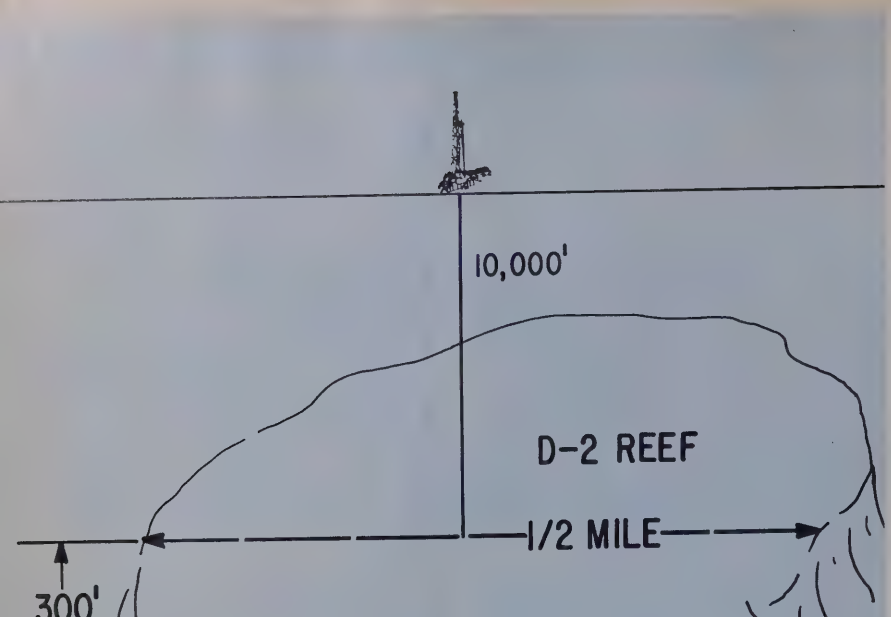
A problem is "noise" or distortion and random vibration, picked up on the seismic recordings. But where in the Fifties each geophone received one set of signals, now twelve different sets of signals are picked up at that point. By computer analysis the constant pattern can be extracted from the random noise far better with "1,200%" seismic than the old "100%." When Chevron's geophysicists and geologists spotted the pinnacle reefs in the upper Devonian layer, they immediately decided it was a good bet.

The reason they were so excited was because the Upper Devonian reefs were prolific producers of oil in other parts of Alberta. However, they also knew this new trend of reefs could still be an expensive disappointment.

Besides, a great deal of the land was held already by other oil companies as part of their efforts to exploit the Pembina field. Of course they'd wonder what was up if Chevron began trying to buy up their rights in quantity. So the multinational secretly arranged that a smaller independent named Nairb would act for them. For three years Nairb painstakingly assembled what land could be got, though it was far from total success even by 1977. A big help was new legislation passed by the Lougheed government. As of 1982 companies holding land by right of production (such rights automatically extend as long as oil and gas continue to be produced on the land) will lose those rights for the zones below their production zone unless they continue to explore further down. Since exploration is expensive, Nairb got many rights holders to agree to a "farm in" deal. If Nairb took on the expense of exploration, the companies holding their rights would give up half the oil and gas discovered.

Secrecy is vital on such plays. Only six to ten employees at working level knew what was going on. Dr. Henderson explains, however, that it is impossible to keep middle and senior management in the dark if the company is to navigate sensibly, so these also knew.

All during 1975 and 1976 seismic exploration continued. Chevron had mapped a couple dozen reefs by the time they had Nairb "spud in" the first well on Dec. 1, 1976. On the first attempt the well casing parted after ten days and the hole was lost. Then on Jan. 17, a date Mr. Henderson recalls with happy ease, the well Nairb Pembina A 11-22 tested oil. In April Chevron openly announced the find and that Nairb was acting as an agent for them. To the company's surprise their revelation sparked virtually no activity. The company drilled at high speed, making three more commercial discoveries and exploring areas surrounding the reefs themselves. And they bought whatever land they could get their hands on. Opines Chevron's exploration chief, "I guess most companies



A pinnacle reef formation

just didn't believe we were on to anything important."

Of course it was too good to go on forever. But the event that triggered the stampede arrived through an unusual twist. Don Getty, then Peter Lougheed's minister of energy, is known more for his careful judgment than for talking out of turn. But during that fall session of the legislature, Mr. Getty stated that he felt sure significant new oil finds would be made. Now since oil explorers by law must turn over all their data to the government, a rule has been passed that the government will not disclose this information for one year in order to protect the discoverer's precious advantage. Some say Mr. Getty had no business even talking about the subject with a major play in the offing. But Chevron considers his words were sufficiently general to remain within the bounds of discretion.

However one journalist announced in banner headlines that a major new find had been made already, apparently reading between the lines of Getty's speech. "There's simply no way that man actually knew what was up," insists Gerry Henderson, claiming only two people outside his company knew the truth. "The reporter phoned me for details, thinking it might be Chevron since we had made that spring announcement." But, technically truthfully, the journalist was told the company had not found a big field. (They were a lot of little fields.) However minister Getty was powerless to intervene. If he denied a big find had been made, he might be accused of lying. If he confirmed it in any way, he'd be breaking the one year secrecy regulation. Within days company stocks were yoyoing up on the Calgary and Toronto exchanges, a flurry matched in the field by moving men and machines.

Exploration chiefs have to worry about more than their own operations. And the constant precautions notwithstanding, keeping track of thousands of wells drilled annually by competitors isn't the simplest task. The second largest player in the West Pembina field is Amoco, with a full or partial interest in 300,000 acres in the area. Byron Richards, Calgary-born and raised, is exploration manager for Amoco's central division (one of three Canadian divisions) and the West Pembina falls in his jurisdiction. A geologist educated at the University of Idaho, he has moved u through the Amoco ranks since 1956. H company has poured $77 million in West Pembina and holds 15 oil well four gas wells plus several others pr ducing gas from a different layer the hadn't anticipated finding.

Chevron's luck (and skill) showe when they first found the pla Amoco's extensive land exploratio rights in the area, purchased muc earlier and held, proved that compan did not lack good fortune and a soun strategic sense. Even before Don Getty fall statement caused the scrambl Amoco that summer had a drill workin south of the Chevron finds. But blowout damaged the hole enough t force a new start and it wasn't till fa that they struck the geological formatio Chevron had hit earlier. In the mean time, operating half blind, Amoco le their leases on some West Pembina lan expire, leases Chevron cheerfully pu chased at later crown sales. But Amoco seismic crews within months had sup plemented the company's data collecte years earlier, allowing Mr. Richards an his colleagues a good look at what wa up.

Till West Pembina nearly all dis coveries of oil and gas that came fro isolated pinnacle reefs were from th Upper Devonian layer known as D3 The new reefs were at D2 level. Virtua ly all earlier strikes at D2 occurred whe D2 reefs sat on oil-bearing D3 reefs. I West Pembina the D2 level contained o completely isolated from any D3 reefs Chevron drilled without being sure if th new reefs, encased in shale, were D3 o D2. Amoco's Richards, sleuthing alon Chevron's trail, decided that these par ticular pinnacle formations must be th target he was looking for. Since the Amoco's drilling success rate has bee over 50%, a record they're proud of. Th company invested 103% of its entir cash flow of 1977 in new efforts for 1978.

Gerry Henderson estimates the new field certainly contains at least 40 million barrels. Optimists are hopin that the ultimate reserve may prove t be upside of a billion barrels. Explora tion is extending north for hundreds o miles as searchers try to chart th borders of this scattering of oil pockets The roll call of companies now in the fiel range from giants like Imperial, Gul Texaco and Shell down to very sma operators.

But according to expert observers few have made money from the new found oil unless they had land rights i West Pembina to begin with. The cost of buying there now on two occasion set Canadian records. Since the field i not continuous, much of the rights hav proved worthless.

LOOD, SWEAT AND TRIUMPH

e drilling drama features a host of players, even spies.

ith 120,000 "dusters" and "gush-ers" (dry and good wells) already ed in Alberta, the province has an age of one well per 2.2 square miles. he industry thumped through the n year of 1978, 5,293 shafts were in Alberta, 1,248 across the rest of da. About 5,000 turned out to be ng propositions. Most were develop-t wells, drilled to further tap known s of oil and gas. On exploration s, called wildcats, a one in ten ess ratio is typical. The end of the oration is not in sight. In the spring 979 virtually every one of the 440 ing rigs available in Canada was g flat out. And lest anyone think 00 wells must be nearing the upper , the Texas total is 700,000 over a area only 5% larger than Alberta.

he provincial government estimates energy exploration employs 12,000 ertans directly, many more indirect-ne industry association study count-5 job categories financially involved illing a single well, from the rough-s themselves to the local grocery e owner. Successful searching for oil gas involves a great deal more than king hole" alone.

he first decision is where to drill. logists and geophysicists decide h are the best prospects. Then a rvoir engineer is called in and the n asks itself a series of complex questions. How productive are other wells in the area? Has this type of rock formation produced good finds elsewhere? How far is it to pipeline and processing facilities? How quickly can oil or gas soak through this type of rock to a well bore? How much would artificial stimulation of that flow cost? If the prospect still looks good, a drilling engineer is brought in to estimate the cost of drilling itself. If higher management agrees there is good potential for profit, money is found and the field crews ordered into motion.

First surveyors lay out and mark the new site. Next a subcontractor's crew prepares the site for the drillers. Trees are cut, the rig and camp locations scraped flat, swampy patches are filled in and, when necessary, rough roads and even bridges are constructed. The mud mixing sump and flare pits are dug. It's little known work but expensive; a single site preparation generally costs $20,000 and $100,000, rising as high as $250,000 if the location is remote and difficult.

Then the rig arrives, driven in by truckers whose task is equally unsung. A good rig hauling crew is judged by the speed it can load and unload up to fifty truckloads of gear plus how well the swampers (laborers) chain down the cargo. A rig tower can be 150 feet high. For short off highway moves, the truckers have figured out a way of moving the tower without disassembly. The base is tied on the flatbed trailer of a vehicle facing forward, the other end on a truck facing backward. When moving, the driver of the rear vehicle is actually backing up.

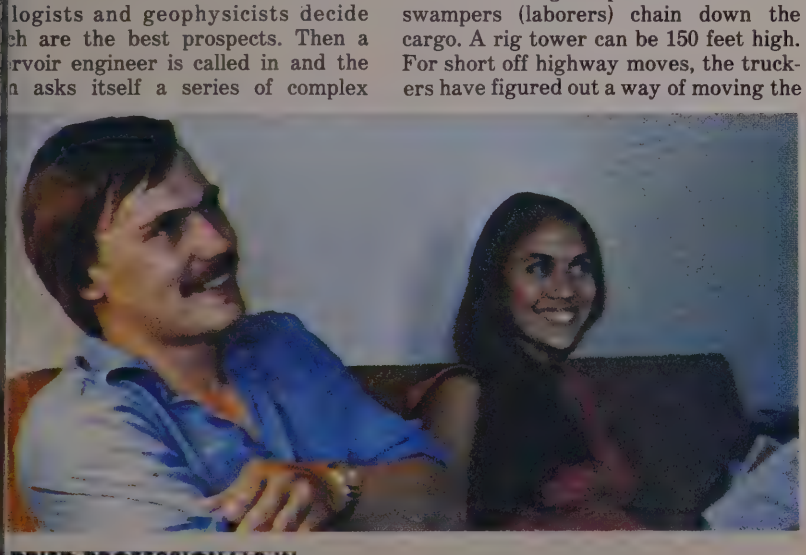
If the well will be deep, the rig used will be large. In that case the first few hundred feet will be drilled by a small, portable rig, cheaper to operate and crewed by gentlemen known as ratholers. But in most cases one machine drills the entire hole.

With exceptions, (notably Shell), few of Canada's 500 or more exploration companies operate their own drilling rigs. They lease both crews and equipment from contractors, typically on a daily basis. The site boss for the oil company is the drilling engineer, responsible for choosing what methods will be used and for overall safety. The contractor's men and equipment are managed by the toolpush, usually a highly experienced man with more practical than formal education.

Rigging up the equipment is bossed by the toolpush, who also gets the portable camp in operation. Starting the well is called spudding in. The drilling engineer follows a program written by his head office, altering it as circumstances require. First the top few hundred to few thousand feet of the preliminary shaft must be lined with steel casing to prevent loosely-packed material from caving into it. Once the rig's safety system is hooked up, the main drilling operation begins.

The familiar derrick is a steel ribbed tower. In the hole itself is the drillstring, a series of 30 feet sections of pipe screwed together, with the drilling bit and other paraphernalia attached to the bottom. Motors provide power to revolve the assembly so the bit will bite into the rock. An engine-powered winch moves the drillstring up and down. A pulley-and-cable system threads from the winch to the derrick's crown (top) and then straight down to where the heavy cable is attached to the drillstring. The entire string is removed to change bits and do other downhole operations. Removing and inserting the whole string is called a trip.

The string can be up to two miles long; "tripping" in or out is hectic, tough work. Each 30 foot length of pipe must be manoeuvered from the vertical storage bin and screwed on within a few minutes (or unscrewed and stored if the rig is



RRIED PROFESSIONALS IN TED PROFESSIONS

ek Baker is a Dome drilling engineer; wife Camille works as a Pan Canadian rvoir engineer. While he's in the bush, 's computing in downtown Calgary's rise forest. Drawn by $25,000 — ,000 annual salaries and challenging work, young Canadians are flocking to the oil patch. And for the first time, significant numbers of women are being hired at the executive and professional level.

tripping out). Larger rigs can handle two or three lengths as a single piece, reducing the number of connections.

The derrick man works on a 6 foot square of slippery steel 10 storeys above the ground in the rig's crown. From there he helps maneouver the upright pipe piece into position over the top of the drillstring already in the hole. The roughnecks who will make the connection work on a 10' by 10' steel deck (the drilling platform) about 12 feet above the hole. Once a stand of pipe is in place to connect, a chain is hand-wrapped around it, then given a motor-powered yank so the pipe threads rapidly into the drillstring. A final tightening is made with huge tongs (specialized wrenches) weighing hundreds of pounds. Assisted by another cable system into roughnecks quickly muscle the tongs into place and twist the pipe tightly into its mate.

Each shift of workers is bossed by a driller, who takes his orders from the toolpush. The driller handles most of the rig's operating controls. When the rig isn't tripping, the derrick man looks after the pumps. Two or three roughnecks handle chains and tongs. During actual drilling, their life is a lot less demanding as new stands of pipe are far less frequently required than during tripping.

For the bit to cut into the ground, the drillstring and bit must turn. A motor revolves the rotary table, a thick steel plate several feet across that is installed in the middle of the drilling platform. The top of the drillstring fits snugly through a hole in this rotary table and special equipment ensures the string is clamped tightly. As the table turns so does the string and, at the bottom of the string, the bit. Revolutions per minute normally vary from 50 to 150. In very easy going, hole can be made at 30 feet an hour; in exceptionally tough rock that can slow to inches an hour.

The spectre that haunts drilling foremen is a blowout. The classic picture of oil gushing high in the sky is associated by the public with wealth, by engineers with disaster. Actually oil blowouts are very rare now; gas suddenly released from the pressure of the earth is more frequently a problem. But new control equipment ensures these accidents are kept to a minimum. In theory a rig crew is supposed to stand fast trying to control a blowout till they're told to evacuate. But many a man, seeing the signs of an impending blowout, has found good reasons to go somewhere else instantly ordered or not. Workers remember well blowouts like Panarctic's 1970 incident on King Christian Island in the Arctic. The entire drillstring was

MUD—*A thick fluid, often clay-based, is pumped from a mud sump to the rig's cro then down the rubber hose in foreground and through the hollow drillstring into the h Mud cools the grinding bit, carries the chipped rock and debris to the surface as it culates back to the sump, and helps seal in any gas or oil reached.*

driven right up through the rig's crown.

There are safety systems on every rig to control blowouts. Two sets of "rams" sit above the hole beneath the drilling platform The rams are tightly fitting sliding steel gates. On new rigs these rams are hydraulic. One set, not normally installed on older models, will close the entire hole, if necessary cutting or crushing the pipe like a tin can. Another set will close tightly around the pipe itself. The pipe can be closed by several valve systems as well. Another major protective device is a bag fitted around the pipe. A flick of a switch will cause the bag to fill instantly with oil kept ready under very high pressure, high enough to hold back a blowout and reduce it to a mere "kick." Still, despite precautions, few rig workers forget that a bubble of gas as big as man's fist when under the pressure of the earth's bowels will have mushroomed to the size of a house as it piledrives upwards into open air.

There are far more usual and less dramatic ways of realizing the drill bit has reached a reservoir of oil and gas. A site geologist regularly analyzes rock cuttings chipped by the drill bit for traces of hydrocarbons. If the cuttings look promising or the drilling has reached a stratum where a find is anticipated, a special diamond-toothed bit is pla on the drillstring to carve out a cylin shaped piece of rock known as a c sample. This is analyzed in city lab tories.

Another sampling technique used measure how much resource is pres is the drillstream test. A speci equipped team of two is brought in. hole is sealed, then the gas or oi allowed to blow within the closed d string. The speed with which press builds up is measured. Pressure ti indicate how much resource is beh the push to the well bore. The tests $10,000 or more and take a couple days to perform.

Before the job is done other cheerful visitors may arrive — an lance helicopters or ground vehi Accidents are common on drilling In the bad year of 1977, seventeen died, in 1976 eight died. Most long t workers have crushed toes or finger happens easily amid the noisy, process of tripping in or out, especial the open, grease-caked drilling platf is being lashed by storm or free wind.

Men have been mashed by machin drowned in sumps, been electrocu breathed poisonous hydrogen sulp gas before they could reach for the

masks, or just fallen off the platform. Government and industry run safety checks and are constantly upgrading safety training. Accident curves rise in proportion to the number of inexperienced "green hands" there are, a figure that soars in times like the present when exploration activity grows intense. Fifteen or more men is a typical annual death toll.

Another unwelcome visitor who may be seen skulking about is the spy. This fellow, working for a competitive oil company, tries to find out if the drilling has uncovered anything significant, something he can tell by a sudden flare after a good drill stem test. He may rent a plane and hover about or just sit quite legally with a pair of binoculars on a neighboring piece of property.

The head of one good-sized company's geology department recalls happily how they dealt with one particularly persistent spy during the testing of a particularly crucial well. "You better not give any name," he warns, "because it was us who broke the law, not him. We just sent over a pair of rather strong friends of ours to where he was sitting waiting to see how our test turned out. We had him bundled off to a spot far away till we'd done the test. Anywhere else kidnapping is serious stuff but in this game it's just another day's work." Other spies, less fortunate, have occasionally found themselves being given a sound drubbing by the rig crew.

When a well has reached the final depth, it is "logged." This is done by a skilled technician, sometimes a professional engineer, aided by two helpers and a sophisticated array of mobile machinery. This team scans the well using electrical, sonic and radioactive devices in a variety of ways as a final comprehensive check on whether or not developing it can be economical. In addition the information can be correlated with logs of neighboring wells to learn more about the entire field.

If logging results justify bringing the well on production, the casing and cementing crews are brought in. These subcontractors use special power tongs to run steel casing down the hole in a manner similar to tripping in the narrower drillstring piping. Next cement is pumped in, filling the well completely and then crawling back up the narrow space between the casing and the earth itself. In this way mud and debris are removed from the well. Then a rubber plug is fitted snugly into the top of the steel casing and driven downward to the hole's bottom with water under pressure. This forces the cement in the casing to escape as the mud did before it, up between the casing and the earth, leaving the well bore full of clean water.

At this point the drilling rig moves on and a service rig, much smaller, takes over. A Christmas tree (wellhead control device atop the casing) is put in place. Using its own small string, the service rig uses small shaped charges to blast half inch diameter holes through the inch steel casing, several inches of cement lining and perhaps six inches into the bedrock. If the well is to be stimulated by acidizing or fracing (see accompanying story), the service rig crew will aid in these operations. If not, the casing is sucked out till the gas or oil pressure blows the water out altogether. The well is complete.

But for many years the reservoir engineers and their assistant technicians will baby-sit their new producer. An average well can flow for at least 25 years, and some much longer. However there are many potential hindrances. As the resource is removed, water may flow into the low pressure area created and ruin the well. Once too diluted, it costs more to separate the water out of the gas or oil than it's worth. Sometimes the oil is too thick to flow readily, such as the Lloydminster heavy oil deposits. Typically 30 to 60% of oil actually present can be recovered though that figure can fall to less than 10%.

Though the difficulties are many and varied, the solutions are becoming equally so. Primary recovery refers to what the well will produce under the pressure of its own reservoir, helped with pumping, fracing and acidizing if necessary. Oil obtained by more exotic recovery methods, some still highly experimental, is referred to as secondary and tertiary recovery. A common method is to flood the underground reservoir with water in such a way the oil is pushed towards one or more wells. Working out the pattern is very complex, made more complicated by the fact the engineers never actually see what happens underground.

PanCanadian is a company exceptionally active in research in this area. They work with miscible flooding. This is similar to water flooding but utilizes one or more chemicals that combine with oil, often another hydrocarbon like butane. If the percentage of the chemical injected that is recovered is high and the percentage of oil recovered also rises, a new technique is added to the growing list. But if much of the injected chemical is lost permanently, the process is too expensive to be worthwhile. Water at least is cheap. Sometimes natural gas is injected underground to create drive pressure.

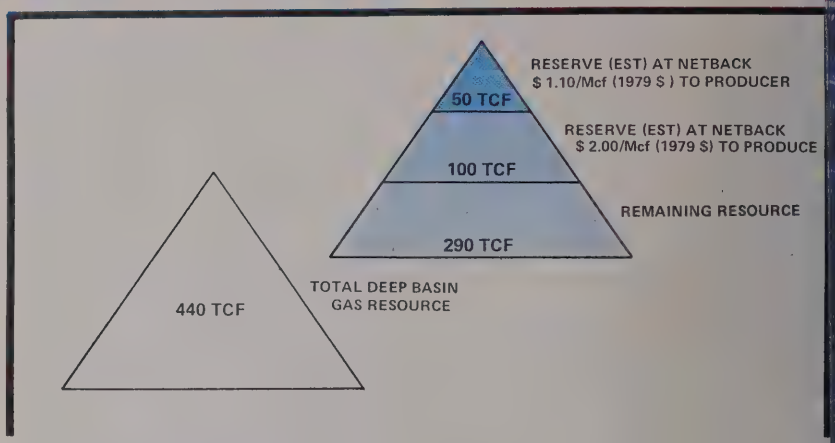
The Lloydminster heavy oil calls for special tricks. This oil is too thick and viscous to flow to a well bore. One method of recovery is fire flooding, setting a fire underground. The gases created tend to drive the oil and the heat induces chemical change that allows it to flow more freely. Another method is to create such motion using steam injected in the ground. An alternate steam method, the huff 'n' puff, is simply to inject steam down a well bore. Once it's had time to affect some of the heavy oil, the process is stopped. The freer flowing steamed oil moves back into the low pressure area it was forced out of and flows into the well bore.

The work of the reservoir engineer may become increasingly critical in years to come as the world's energy reserves of conventional oil and gas diminish. If research can discover technology to substantially increase the recovery ratio from known fields, Canada will in effect acquire new reserves.

Drilling platform
Note tongs with supporting cables, rotary table with drillstring jutting up, and mud filling drillstring to brim

THE DREAM TEAM OF MASTERS – GRAY

Canadian Hunter's two partners had little going for them but a borrowed desk and faith—often punctured—till persistence broke the barriers to a trillion cubic feet of gas.



The resources triangle
At the top, what's already economic; in the middle what technology and higher price would make economic; at the bottom the mass that is spread too thin to ever be economically recoverable.

Asked why he found the Alberta oil patch an exciting place to work, one new Calgarian recently replied that "here tomorrow's legends are walking the sidewalks today." If so, two of the stronger candidates for future myth-making are John Allen Masters and James Kenneth Gray, founders of Canadian Hunter Exploration. Already they are regarded by their peers with that mixture of scepticism, respect, fear and hope typically reserved for prophets among their own people.

Six years ago when Canadian Hunter began in a borrowed office, its assets consisted of one desk — also borrowed. Today by conservative estimate, the company holds over a trillion cubic feet of natural gas reserves. Even after government royalties and tariffs, at present prices a trillion cubic feet (tcf) of gas is worth over a billion dollars.

In the past couple of years, the most hardened cynics among the oil and gas fraternity have had to listen over and over to the headline-grabbing Hunter prophecy that Albertans control quantities of gas beyond their fondest hopes. And a great deal of gas has been found, much of it by aggressive young Canadian-owned companies. Now the energy establishment of all Canada pays nervous attention as Jim Gray proclaims from every available platform: the Canadian-owned sector of the industry will largely die if this growing glut of gas is left too long unsold.

Nevertheless it survives. More important than money or even any single idea in the success of Canadian Hunter is the intellectual partnership between John Masters and Jim Gray. Describing it "like electricity," Mr. Gray recalls this "natural bond formed on day one."

Though their records were good, before that neither had run enough ahead of the pack to attract any public attention. Mr. Masters studied geology at the University of Colorado and economics at Yale. He went to work for the U.S. Atomic Energy Commission then for Kerr-McGee Corp. in the U.S. and subsequently took charge of Kerr-McGee's Canadian operation. Today at age 52 he's president of Canadian Hunter. Jim Gray, Hunter's executive vice-president, is 45. His father was a mining engineer at Kirkland Lake, Ont. After studying geology at the University of British Columbia, he worked for Norcen. In 1963 Mr. Masters hired him as a geologist for Kerr McGee of Canada and the current began to flow.

While working with Kerr McGee, the two shared and developed ideas about what were then unorthodox methods of recovering gas in areas generally considered uneconomical in Canada. With his long experience in the U.S. where gas prices historically had been higher, John Masters was versed in technique and theory till then largely ignored by the Canadian industry. The two found that, when one suggested an idea, the other could leapfrog ahead with it. Then both would consider its development, searching for a further step. They shared the conviction that gas prices would rise from under 20 cents per thousand cubic feet, possibly to as high as 80 cents by 1980. The price is now $1.10 per thousand cubic feet but back then such talk was usually considered pie-in-the-sky thinking.

But the "dynamic duo" (as they are frequently called by their colleagues) could not convince Dean McGee, head of Kerr McGee, that the chains of ideas they'd built were worthwhile. The crunch came when John Masters was faced with a forced transfer back to Oklahoma City and the end of the Alberta dreaming.

The well-known story goes that Jim Gray got a call from his partner, who said he had both good news and bad news. "The good news was that he'd quit Kerr-McGee and would be staying in Canada." And the bad news? "He said he'd quit for me, too!" Though he's told it many times, Mr. Gray still laughs at the memory.

Canadian Hunter's story breaks naturally into three phases. In the first they were searching for financial backing for their ideas. In the second they were another of the unorthodox independents (much like Alberta Eastern and Universal Gas). In the third they were the initiators of what may well be the biggest gas play in Canadian history, the Deep Basin.

The hardest was the first stage. The year 1973 appeared the worst possible moment to be looking for exploration capital. Due to the provincial-federal royalties squabble, most companies were cutting back their exploration programs until government policy became firmer. The recession lasted all during 1974. But the pair preached their message anyway.

The kernel of that message was the lesson of the resources triangle. The Canadian Hunter theory symbolizes the entire amount of any one resource as a

)hn Masters, president
ne dynamic...

angle. If the element gold were in estion, the area of the triangle would ntain all the world's gold, including the ndreds of millions of tons scattered as lated atoms in sea water. Naturally st gold cannot be brought to market. parating it from the rocks or water t it's chemically bonded with is too pensive. The small portion that is nomically recoverable Mr. Gray com- es to the tip of the triangle.

At the very tip would be pure gets you can just pick up. A little er are the really high grade ores. But st gold, like gas, is in the big bottom the triangle. Over centuries the nomically recoverable percentage resented at the triangle's top has ten larger. New technology was eloped to satisfy bigger demands by anding population."

e notes that when first discovered erta natural gas had no market ss it happened to be both very pure so close to a town it could be piped ctly to homes. Then pipelines to ern and western coast markets were t. The area representing exploitable reserves on an Alberta gas resource ngle has become much larger in the 20 years.

anadian Hunter anticipated that en- prices would rise. That would mean fields which weren't economical when d would become very profitable. erta has forced exploration com- es to conduct extensive testing ring) on any well, economical or not. result is data is available on over 000 wells. Unlike the U.S. practice, in Canada after one year that information is public. The science of re-analyzing the results of these tests had already been highly developed in the U.S. where prices had risen much earlier. The new company hoped to cash in on this situation and others.

Particularly important is how the pressure of a new well's gas acted when allowed free release. Sometimes wells thought almost dry were really good. Low gas flow readings could result from damage during drilling. If the pores in the rock or sand around the hole get plugged, gas can't get into the well bore. In the days of cheap world oil and low value gas nobody bothered working out ways to read what truths lay in these well "logs" or records.

But in 1973 Jim Gray and John Masters hoped these exotic but unspectacular gas reserves could attract investors. "We went to different manufacturing and financial companies down east. The response was always the same," recalls Mr. Gray. "The president would be all enthused by my pitch. Then later he'd arrange dinner with some so-called expert he knew. That guy would tell him we were wingy and anyway gas was something everyone was piling out of. We always had several on a string, adding more while the earlier ones dropped away." It was disheartening but, when one partner's spirits were low, the other would at that particular moment be feeling more optimistic. Comments the vice-president, "Alone I doubt either of us could have done it."

The big break came in the persons of Alf Powis and Bill Row, respectively president and chairman of the board of Noranda Mines, a Canadian-owned giant. Mr. Row was a very close friend of Jim Gray's father. So when he visited Calgary (as a director of Panarctic Oils) he always checked in to see how things were going. Noranda was familiar with the idea that large ore bodies exist in low grade (highly diluted) deposits. In their mines they would often leave a seam of poor ore in the ground till prices rose. So far Noranda's ventures in oil and gas exploration had panned out poorly.

Alf Powis believes that "when everyone's leaving and you see a reason to stay, that's opportunity." Noranda agreed to provide $25 million over five years and took over the financial backing for the fledgling company. What personal share the Masters-Gray team was able to secure for themselves financially has not been released. Now that they had some money, Canadian Hunter surged into exploration and also began assembling a staff. The recession that had seemed their death knell had brought in Noranda, ready to exploit a field now rapidly clearing of opponents.

The partnership between the two men deepened as they learned. John Masters, in the words of one employee, is "just brilliant." He masterminded the exploration rights buying, farming in and out partnerships, and outflanking that led Canadian Hunter into fields from Lethbridge to Key River. While Jim Gray and others expounded ideas at strategy meetings, the Hunter president listened. Then he'd add his own and glue it all into one winning streak after another. Vice-president Gray's talents lay more in raising money, dealing with the public, recruiting personnel, and, above all, translating strategy into reality. As he puts it, "John's 70% theoretician, I'm 70% line manager and promoter but 30% we have in common."

The pair are of course deeply dyed with the free enterprise philosophy that pervades the Canadian corporate oil community. Nevertheless they have developed what could be called radical capitalist reforms. The most basic is similar in a sense to the "permanent revolution" theory of Mao Tse Tung. The Chinese Communist leader advocated constant social upheaval to strip away the deadwood and inertia of bureaucracy. Recognizing the same sort of problems in the massive organizations of the multi-national oil giants, Canadian Hunter has developed an ideal of constant technological innovation.

As John Masters puts it, once an opportunity is generally known, it's pretty well gone. The only way to stay ahead is to be always at the leading edge of new ways and means of finding and recovering energy. He and Jim Gray led

Creative Associates

Jim Gray, vice-president
...duo

a series of personnel raids at the highest levels of the industry. The result is a corporate management labelled, not always affectionately, "the Canadian Hunter dream team." Their job is to stay one step ahead of the pack in adjusting to constant changes in industry methods, materials, and machines. In another capitalist-style reform, over 40 of the company's 100 employees have been awarded profit-sharing status in the enterprise. This very high ratio of profit-sharing boosts morale, partly for financial reasons and partly because each member chosen knows it's a personal judgment on the merit of his work by the two company founders.

Again in a manner reminiscent of Mao, Canadian Hunter evolved tactics that enabled a small, lightly equipped force to take on and beat much larger groups. The Hunter equivalent to the guerrilla raid was the small but profitable oil and gas play, operations requiring skill and speed to exploit more than large amounts of cash. Mobility was increased by very intense use of consultants, independent experts who are hired only when they're needed. At times Hunter, with well under 100 employees then, had up to 300 consultants working for them. And the "dream team" is encouraged to pair off into intellectually reinforcing sets like their bosses.

The Canadian grip on its own oil and gas industry is increasing, often because men like these find better ways to do their job. But Jim Gray concedes permanent change isn't feasible in the long run. "Inevitably we'll petrify to some extent as we grow. But for now we're all just loving the speed of the climb." He believes Hunter's current success and technical lead stem from having recruited personnel highly trained in recovering low grade reserves. "When things get scarcer, you need more skill to find them." A long series of little successes and this pool of skill, combined with good luck, led the company into the big time in 1976. From small "rabbit" plays they moved into the league of "elephant" operations.

Almost eighty million years ago, Alberta lay submerged under an ocean stretching from the Gulf of Mexico to the Arctic. It wasn't the first and it would be succeeded by others, each leaving layers of sediment on its bed. Over eons, complex chemical processes not yet fully understood transformed remnants of plant and animal life into petroleum and gas, trapped in some of these sediment layers. When the Rockies thrust up, buckling caused the earth's surface to sink beside the new mountains. So the old ocean beds, piled in layers, now slant gradually downwards as they stretch east to west from Saskatchewan to the foothills.

Historic Elmworth Number One
A service rig testing the well.

Between 1973 and 1976 Canadian Hunter geologists came across more and more samples of a very peculiar phenomenon. Scattered here and there across 26,000 square miles of western Alberta and northeastern British Columbia they found gas and occasionally traces of oil lying "downdip" from water. As the sedimentary layers sloped down towards the foothills, the gas was lying to the west, lower than the water. Normally gas and oil, being lighter than water, are forced by the earth's pressure to seep upwards along the layers of sediment till they're sitting above water. However repeatedly in formations like the Bluesky and Cadotte (different sediment layers) the water was above, the gas below. The intriguing phenomenon led Hunter into a search for an explanation.

In this area the formations have long been known to be very "tight." In most zones pressure had crushed the space between the grains of earth material (sand or rock) so heavily that next to no space was left for gas to collect. In addition, sometimes what spaces did exist were hooked together so poorly that gas could flow only very slowly through the earth to a well bore. (This is termed low permeability.) A lot of samples of foothills rock taken while drilling looked like street concrete. By contrast in good Devonian reef (as at Leduc) the holes in the rock look like they were made by burrowing worms. Industry had long since written off what gas had been found in this area of the foothills as too tight to produce economically.

But Canadian Hunter, a team well versed in slow flowing "tight" gas reserves, decided to investigate. In January 1976 an exploratory well was drilled to 10,000 feet at Elmworth, near Grande Prairie in northwest Alberta. Over this 10,000 feet of rock, twenty zones were spotted as containing some porosity (space between grains for gas to collect) and permeability. In most wildcats (exploratory wells) many if not all of these zones would have been wet (water-bearing). But to the astonishment of the Hunter analysts, 19 of the 20 were gas bearing.

Quickly Hunter drilled several "step-out" wells nearby. Incredibly this same phenomenon was repeated in well after well. Meanwhile analysis of old well logs from previous drilling attempts up and down the foothills chain (as much as 200 miles from Elmsworth) showed the same thing . . . gas in almost every streak of porous rock. In March, 1976, over three years of collecting scraps of unrelated information resulted in a single gas play of staggering size. In the mind of John Masters, who spearheaded the entire effort, the concept of the Deep Basin was born.

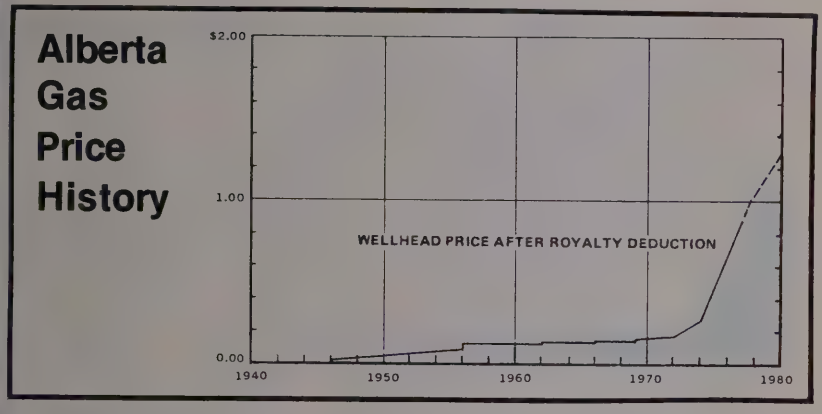
He judged that much of the 26,000 square mile area was saturated with gas between 2,000 and 10,000 feet below the surface. He decreed that Canadian Hunter would go all out to acquire land rights. Drilling went ahead full speed. The company began negotiating farm-ins (sublease given in exchange for a percentage of any find) with other companies that held the rights to much of this vast area. The oil community watched, puzzled. Why was anyone going to so much trouble over gas thinly spread and locked so tight that almost none could get out?

"A lot of people were scared of us," says Dave Smith, head geologist at Hunter. "A lot of folks weren't shy about calling what we were doing crazy. But still they had to wonder if we didn't know something they didn't." If a company jumped in, it could lose a fortune on a hare-brained scheme it didn't even have spelled out. But if it waited opportunity might be missed. Everyone waited.

How big a bonanza in the Deep Basin?

Canadian Hunter did know something he others didn't. True, the formations were mostly very tight. In fact that was why the gas was downdip from water. As the sediment layers sloped down, the overburden on top of them grew heavier, crushing them. For unclear reasons, not yet understood, water can only penetrate downwards so far under those conditions, then stops, leaving the gas. A similar U.S. field, the San Juan in New Mexico, has produced 13 tcf of gas. Though not crucial, one Deep Basin plus is that water creates no problem in recovering the gas. But the real winning factor is the "sweet spots."

What the onlooking experts didn't realize was that at Elmworth one layer wasn't tight and was producing very good gas flows from large reserves. This layer, known as the Falher (pronounced



The history of natural gas prices.

fallair), is made of gravel pressed into rock. Good flow space (porosity and permeability) survives between the large pebble of the gravel despite the crush. In other places in the Deep Basin rock has fractured, giving a better flow than expected in such tight formations. In still other places, sweet spots occur where the earth's chemicals have eaten holes in the tight rock, again allowing more flow. Since so many layers produce, cumulatively even poor flows from several zones can add nicely.

But its geology is not what has made the Deep Basin Canada's most controversial energy play. The difficulties have been arising ever since, as people try to assess what all these new theories mean to the rest of the economy and to Canada's gas exports policies. The Canadian Hunter drilling data became public after the usual year of secrecy (protection given by law; after that the government releases the information). The competition stopped scoffing and got busy. Most major companies are now active in the area to one degree or another, some very heavily. But many still doubt the Hunter theory that the Deep Basin contains 50 trillion cubic feet of reserves recoverable at today's prices. Beyond that, the Masters-Gray theory goes on, lie many more trillion waiting for price rises that are virtually inevitable given the scarcity of energy.

So the paradox that ninety drilling rigs are boring full speed for companies that disagree heavily over how valuable what they're investing in is. While Hunter sees the sweet spots as interim carry-over till new technology and prices bring vast new Deep Basin reserves into reach, other experts see the sweet spots as the major prize.

Land rights have rocketed past $20 an acre (the beginning low) to as high as $1,000 an acre. Over 250 wells have been drilled in the last two years. Hunter bases its 50 trillion cubic feet on analysis of old well logs, current drilling, and geology. But they concede the final confirmation must still be more drilling and it will take over 3,000 wells to draw out the full story.

On any scale, it's a significant find. One independent consultant placed the area's reserves at a minimum 2.6 trillion cubic feet. Then in 1978 Imperial Oil bought the rights of 17.5% of the production from the two million acres Canadian Hunter owns all or part of. (In the proven Elmworth area Imperial's share will only be 12%). Since 80% of the smaller company's holdings are in the Deep Basin, evidently the kingpin of the industry is convinced Hunter's hopes are reasonable, at least partly. Imperial has yet to endorse in any public way the Masters-Gray estimate of 50 tcf of now recoverable gas. Including royalties, that much gas could be worth over $100 billion and could supply Canada for 25 years.

However the National Energy Board's figures the Deep Basin for a gas reserve of just one trillion cubic feet. The Ottawa mandarins accept the Falher gas as definite but discount the tight formations altogether. By all accounts the methods the NEB uses to calculate reserves are conservative, though they never release any details of how they arrive at their figures. Traditionally government and consuming industry have heartily applauded the NEB's caution. For their planning, it's reassuring to know there will always be at least what the NEB says is there. To arrive at what quantity of gas the government will allow to be exported, Canada's needs for the next 25 years are subtracted from the total reserves. So a low total reserves figure means a low surplus for export.

Frustrated, Jim Gray calls the NEB's calculating system "conservative but not prudent." Canada cannot absorb what gas is available now. If more exports to the U.S. aren't allowed, Mr. Gray believes the greater part of the Canadian-owned sector of the industry will die for lack of revenue within a decade. Canadian Hunter this year will spend $150 million alone. This plaint is heard from all the independents, afraid they will be forced to sell their holdings to foreign multi-national companies with far greater cash reserves.

The idea of the fruits of Canadian daring and ingenuity falling to outsiders because of Ottawa timidity arouses the full missionary zeal of Mr. Gray. "They're scared we'll sell everything but the kitchen sink to make a buck and leave the country stranded. If they were energy explorers themselves, they'd understand that there's far worse danger in crippling the Canadian companies that can find more energy in gas, tar sands, coal and whatever else the future holds. There's always more if money and initiative are left to find it. But if we independents are financially crucified, everything we can do for this country and its economy will be lost."

The politicians in Ottawa are already catching flak from edgy central Canadian gas consumers for exporting too much gas even now. From any podium he has time to fill, Jim Gray fights back, the ex-officio spokesman of his industry. In his own office, with his jacket slung as usual over a chair, tie and collar loose, he backs his verbal punches by handing out bilingual buttons. They come bluntly to the point. Among button collectors their fame has already reached the United States. The message: get off your ass and sell that gas.

FIRST LADY

Thelma Cameron, pioneer woman landman.

Long before the bra burners performed for color television, Thelma Cameron was field boss for twenty men. In an overwhelmingly male industry, she played an exciting part assembling two of the key oil plays of Canadian history. Born to farming parents in 1912 and raised in the southern Alberta village of Vauxhall, she faced the Dirty Thirties as a young stenographer. Though the oilmen were suffering even more than most, this determined lady, looking younger than her years, managed to land a job with Calgary lawyer-promoter Hugh O'Rourke.

The Turner Valley field was sputtering but otherwise the West's promising geological formations had thus far proved as dry as the dust drifting across Alberta's parched plains. But some oilmen kept plugging. "I am damn proud of those early promoters. They worked till they died to develop what we have today." Thelma Cameron recalls that in the oil patch of that day bargains were often sealed with a handshake, no one bothering to draw up papers. A secretary's pay was often skipped for lack of cash. Her eyes flash even now as she remembers, "The moneybags my boss kept going to see in Toronto and Montreal weren't talking about 'sharing the national wealth in the common interest' then, I can promise you."

When her boss died, the desperate woman walked into a Calgary dry goods store, announced she would work a period for free to prove herself, and refused to budge till she was given a job. She was. Several years later she did a little work for another promoter, then joined Carl Nickle's fledgling *Daily Oil Bulletin*. Though subsequently the publication became its prosperous self, "Back then things were so lean we frequently had trouble getting enough news to fill a single sheet." As assistant editor ("That meant I did everything.") Thelma Cameron continued to get to know the industry and the men who ran it.

She married Stu Cameron, a cartoonist whose sarcasm had so infuriated that prophet of the prairies, "Bible Bill" Aberhart. It was under the next premier, Ernest Manning, that the electrifying strike at Leduc in 1947 finally proved the geologists right. One of them was Dr. William Howells, a senior manager of Texaco Canada's corporate ancestor, McColl-Frontenac. A lengthy string of unsuccessful wildcats (exploration wells) had earned him the sobriquet Dry Hole Howells. Shortly after Leduc he happened to lunch with Carl Nickle.

After their meal the two returned and announced to Mrs. Cameron that she had a new job with Dr. Howells. She would become a buyer of mineral rights, trying to acquire lands he wanted before the competition did. She would have to learn to thread her way through the maze of property records and legal regulations governing oil activities and acquisitions. For this she would receive the princely wage of $10 a day. Feeling eager, nervous and railroaded, Thelma Cameron agreed to become Canada's first female landman.

Thelma Cameron's baptism took place with a play near Mundare, 50 miles east of the Alberta capital. She secured 90% of the necessary leases within three days, before the competition realized a woman landman was in their midst. "Oh, after that I think I was given an even tougher time than most, just on principle though goodness knows competition was fierce anyway." The neophyte also evolved her modus operandi. On hitting town she'd get a bed at the frequently ramshackle town hotel. Then she'd find one or two local men whose reputations were solid and trusted, often a grain elevator manager or implement dealer who knew everyone for miles around.

Thelma Cameron
Making good in a male world.

hese she would convince to operate as one-time commission salesmen us give her the lay of the land. Then e'd hire a driver and race with him out the countryside, constantly pe- sing her suitcase full of title searches d contracts. "Id eat in some Chinese feteria but it was no problem if there asn't one open." The local farmers, equently of eastern European stock, ould constantly invite this pretty city sitor to what seemed a non-stop ccession of feasts celebrating birth, arriage, and passing on to the world to me. "By the time the drinking and ncing was done, I'd have half the gnatures I needed locked up. It was n."

The roads were sometimes quagmires. coup she recalls with delight is making r pitch successfully to a Mennonite ho was helping her pull her vehicle out a ditch full enough to have flooded the ck seat. "By his clothes I knew which e on my list he must be so I greeted m by name. He was so impressed he gned." Some rural folk are so leery of cuments they couldn't make head nor il of them they wouldn't budge. Many oke limited English. "The technique used for these was to get them off the manure pile and into town." She recalls one case of a St. Paul couple who finally consented to come to her suite in Edmonton's Hotel Macdonald and talk with a lawyer they knew in town. The lady's jaw dropped at the sight of the lobby chandelier. They made the lawyer explain every clause in turn for three hours, still didn't understand very well, but signed anyway.

The CN's Hotel Macdonald was the only sizeable hostelry in Edmonton, a preferred address for any landman. In those boom years in the later Forties guests could end up in the bathrooms and furnace rooms. When a nearby hotel burned down, Mrs. Cameron invited several competitors to bunk temporarily in her room. The tradition stuck. Out of pity a road contractor once paid a phone bill of hundreds of dollars for calls she'd never made. On another occasion, exhausted after a day in the field, she returned to find her room plugged with twenty people dealing and drinking. She went to the bathroom, marched out in her nightgown and went to bed, pulling the covers over her head to shut out the racket. In the morning she awoke to find sleeping figures draped about the room.

Oilmen place a high priority on assembling all the rights to whole areas. Gaps in their parcels allow their rivals to drill close to any finds made. Veterans recall Mrs. Cameron as a formidable performer who habitually pulled in 90% to 100% of any block she was assigned. Her reputation was given a powerful boost during a play near Spruce Grove 15 miles west of Edmonton. Texaco already had a rig sitting on a rail car in the Edmonton yards, ready to make a hole at a specific, secret point. Mrs. Cameron was frantically trying to cope with a couple of dozen hold-outs so the show could get going. In the end she was down to one couple who insisted on dealing through an Edmonton lawyer.

By this time the easy money had corrupted not a few. If a man was working for her, the woman landman had to keep an eye cocked that he didn't secretly start working for another company. Some landmen conned owners into bad bargains. A few lawyers made a practice of getting paid for legal services by accepting 10% of the supposedly valueless mineral rights of their client's land. Mrs. Cameron suspected the lawyer for this stubborn Spruce Grove couple was one of these. The amendments he proposed to the lease contract she'd offered the couple rendered the document worthless.

"I stepped into his office and his receptionist called him into the waiting room. He looked me over disdainfully and asked if I was a lawyer. I said I wasn't and we exchanged some increasingly unfriendly words. The couple were watching as I edged to the door. Then I lost my temper finally and asked him, 'And who are you, you son of a bitch, one of those bloody ten percenters?' His big red face yelled and he slammed the door in my face. As I walked out on the street, the couple caught up with me, said I'd told the truth, and signed." Nervous that her company might consider her actions unfit, she returned to Calgary by train. And she walked down Eighth Avenue, her friends kept stopping her and offering their congratulations for giving the old rogue what he deserved.

Spring 1949. Thelma Cameron decided to branch into the burgeoning plays springing up across Saskatchewan. After a hectic first trip, she returned to Calgary with rights to 80,000 acres in a suitcase, still uncounted. She sold them in one afternoon and returned with contracts to buy more. In Regina she set up an office staff, then put twenty men in the field.

"Truly it was a roller coaster. A commission salesman you hired for a one shot deal today would be so impressed by what he earned that he was your competition tomorrow." There were other headaches. "I remember one fundamentalist lay preacher I hired. People would sign for him. But getting each wording change in the contracts initialled by the other party seemed too much for him. I'd send him back several times if necessary to get those initials. Unless it's perfect, the paper's worthless. He did eventually learn but by the look of his wife, I'd say he gave her a hard time over it sometimes." The last time she saw him he marched into her office and, while she was still wincing at the sight of him, announced that she had overpaid him. His employer still wonders what gave him the most satisfaction, being honest or thinking he'd caught her making a mistake.

By 1952 Thelma Cameron was feeling a trifle worn out by the landman trade. "So I went into three wildcat wells and lost a wad of money. Oh well, it's all in a life." However she managed to make her daily bread, if not more, playing the business she now knew so well from the investment end. Her tradition is carried on by increasing numbers of women in land work as well as engineering and executive fields. The national landmen's association broke down and now allows women to join. Female employees are already common at the technician level and, though still rare in boardrooms and executive suites, have gained a toehold there as well. Resistance is fading visibly in an industry that respects success above anything else; however women are still refused entrance to that place of prestige the Petroleum Club, before 3:30 p.m.

ALBERTA REPORT

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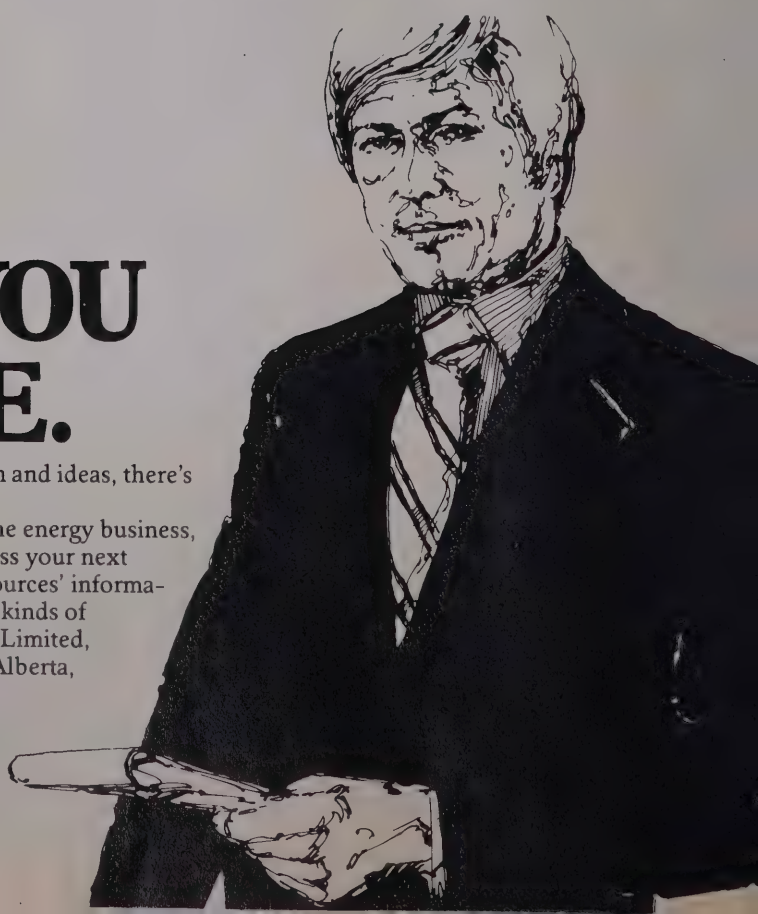

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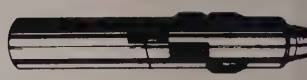

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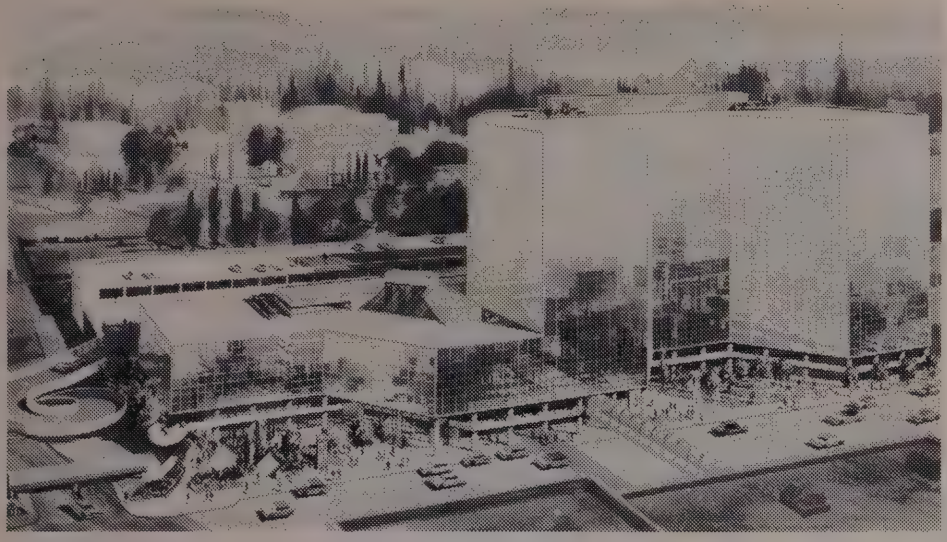

Waste not, want not.

At Gulf Canada we've been advocating energy conservation for years. And Gulf Canada Square in Calgary is just one example of how we practise what we preach.

When completed this fall, the Square is expected to be the most energy-efficient office complex in the world. It won't use furnaces or solar heat, but will get all its heat from lights, office equipment and occupants. Per square foot, it will use less than one third the energy consumed by conventional office buildings in Canada.

Why conserve? Because we have no choice. Canada may not always be able to import all the oil it needs, regardless of price. So, energy conservation is vital if Canada is to remain self-reliant.

Over the past six years Gulf Canada has reduced energy consumption in its refineries by more than ten per cent, and has saved the equivalent of one million barrels of fuel oil. That's enough to meet all the energy needs of an industrial city the size of Toronto for three days.

The longer-term objective is to reduce fuel consumption in our refineries by a total of twenty-three per cent by 1985.

Think of the energy savings if all Canadian industries and families could achieve similar economies.

Conservation alone won't assure Canada of adequate energy in the future. We must continue to invest in the development of our various energy resources.

But conservation of resources — especially energy, which is so vital to the well-being of all Canadians — makes good sense. Gulf Canada Square is just one more example of our company's successful conservation efforts. There are many other ways it can be done.

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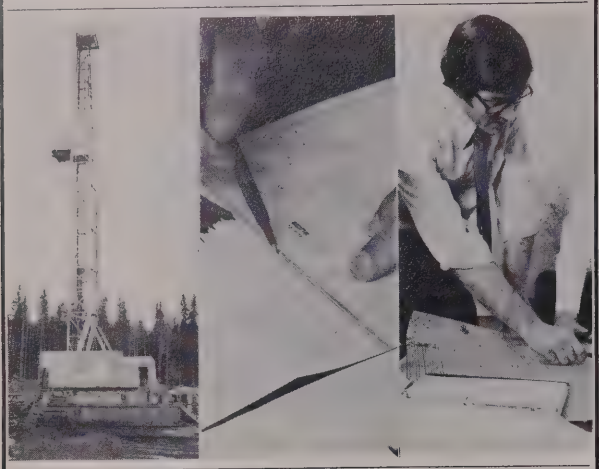

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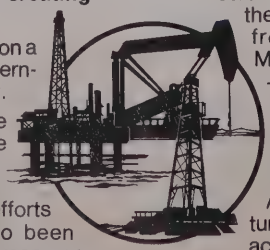
The search is taking PanCanadian, one of the largest Canadian-controlled hydro-carbon producers, all over the world. It is also creating record activity right here at home.

Petroleum exploration in Canada has taken on a new vitality due largely to progressive government policies and an improving technology.

Important oil and gas discoveries have been made in the Deep Basin near Grande Prairie, and PanCanadian is playing a major role in the exploration and development of reserves in this area. Exploratory efforts in South and Central Alberta have also been successful and have added to oil and gas reserves. PanCanadian is also participating in exploration in Saskatchewan, British Columbia and the Arctic Islands.



In addition to extensive efforts in Canada, PanCanadian is strengthening its position in the United States. The Company has exploratory programs in the key oil and gas producing states that stretch from the Canadian border to the Gulf of Mexico.

The North Sea continues to be an active area for petroleum exploration, and PanCanadian has acreage in both the British and Dutch sectors. Eight thousand miles away, in the Indian Ocean off the northwest coast of Australia, PanCanadian is looking to the future, where it has an interest in eight million acres.

No matter where the likeliest places are, PanCanadian will be there exploring for new supplies of energy for Canada and the world.

PanCanadian Petroleum Limited

What have you got to lose?

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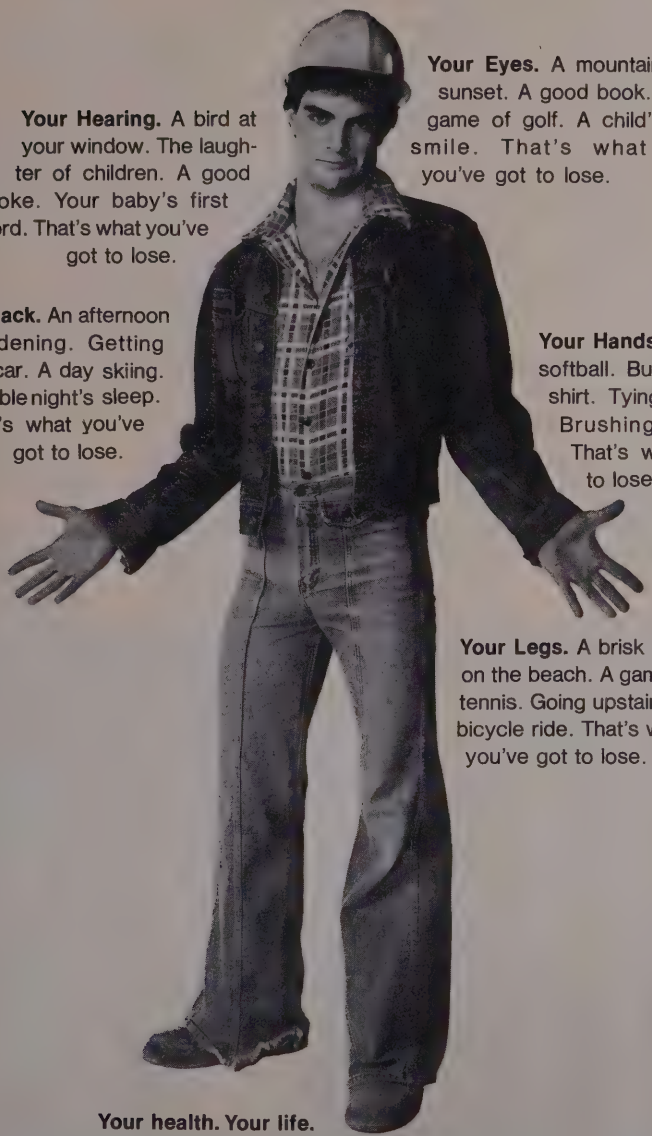
Your Hearing. A bird at your window. The laughter of children. A good joke. Your baby's first word. That's what you've got to lose.

Your Back. An afternoon of gardening. Getting into your car. A day skiing. A comfortable night's sleep. That's what you've got to lose.



Your Hands. A game of softball. Buttoning your shirt. Tying your laces. Brushing your teeth. That's what you've got to lose.

Your Legs. A brisk walk on the beach. A game of tennis. Going upstairs. A bicycle ride. That's what you've got to lose.

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Sulpetro Limited is a Canadian-controlled company with head office in Calgary, Alberta. It has been actively engaged for twelve years in acquiring petroleum and natural gas rights in Canada and in the exploration for and the development of hydrocarbons. Most of the Company's activities are in Alberta but it has recently extended its exploratory activity into British Columbia and has acquired exploratory acreage in the Northwest Territories.

The Company's landholdings total 8.5 million gross acres (1.7 million net acres). It has proven reserves of 206 billion cubic feet of natural gas and 2 million barrels of crude oil and natural gas liquids. Gas production averages 18 million cubic feet per day.

Sulpetro's main exploration effort currently is centred in the Elmworth-Wapiti and Karr areas of the Alberta Deep Basin and in the Valhalla-Clairmont-La Glace area immediately north of the Deep Basin. The Company has enjoyed good success on its extensive acreage in these areas and plans a continuing exploration program there.

By November 1, 1979 the Company will have its 50 million cubic feet per day Elmworth-Wapiti gas plant on stream and, at the same time, plans to commence export of 22 billion cubic feet of gas annually to the United States.

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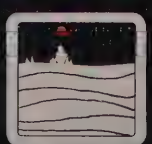

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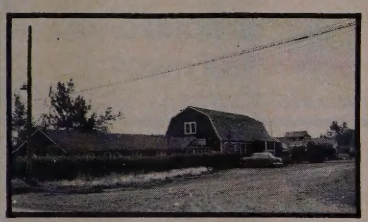
50 Years of Service to The Canadian Petroleum Industry

In the early summer of 1929, brothers eorge and Paul Halliburton and two mployees formed the entire work force Halliburton Oil Well Cementing Co. d. of Canada. They operated two twin-ump steamp powered cementing units ervicing the cable tool drillers of Al-erta's fledgling oil and gas industry in 'ainwright and then Turner Valley. wned by George and Paul's brother, rla Palmer Halliburton who founded the arent company in Duncan, Oklahoma, ur years earlier, it was the first oil well ervice company anywhere in Canada. eadquarters was a log house in the nall settlement of Naptha, about four iles south of present day Black Dia-ond.



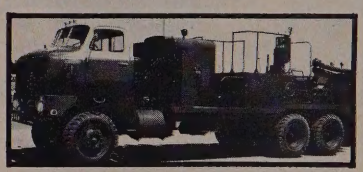
Today, fifty years later, nearly 700 alliburton employees from Tuktoyak-k to St. John's, Newfoundland, stand eady with the most modern equipment nd technical skills available in the well ervice industry. Many of these, includ-g pneumatic bulk cement handling, rbine engines, nitrogen services, in-atable packers, Class "G" cement, nco bulk mud, and Welex computer gging units were pioneered for Halli-urton's use by the Canadian company. eginning in 1920, more than 50 patents ere issued to founder Erle Halliburton uring his twenty-seven years as Presi-ent, and the Canadian company has ept alive that spirit of innovation. The ivision laboratory was established in 954 and the unique Calgary Technical enter built in 1978. With almost 40 raduate engineers on the payroll, Hal-burton remains at the forefront of re-earch and development.

Staying at the top has required no less stamina and ingenuity than getting there initially. Hardly a year after the company was established in Canada, the depression hit and investment in oil exploration dried up. Some wildcatting continued, however, and George Halliburton kept the company going while Paul returned to the United States. Though by the mid-1930's, there were only 11 rigs operating in all of Western Canada, there was never any question that Halliburton was here to stay. Said Erle Halliburton, "It is not my idea to just make money out of a country, but to develop it and to raise the economic standards of its people." Even George Halliburton's untimely death in a trucking accident in 1936 didn't alter the company's determined growth.

Those who succeeded the family management shared its dedication, and a new era of expansion began in 1937. New equipment, including the first string of Drill Stem Testing Tools to appear in Canada, was brought in and Halliburton was ready for the upswing in drilling activity that came in the Spring of 1938. The rise continued at a steady pace, and the following year Halliburton introduced the first Electrical Well Logging service to Canada, and added Perforating service in 1940.

Steam powered cementing units gave way to gasoline and then diesel, followed by improvements through eight generations of high pressure pumps.

The Second World War boosted drilling activity, and service locations were added at Taber and Vermilion. After the war came a surge of investment in the petroleum industry. Halliburton immediately opened a large operating base in Edmonton, followed by uninterrupted expansion to serve every area of wildcat exploration across the country. Canada's pioneer well service company has operated from locations established in ten provinces and the Northwest Territories. The first fracturing job in Canada was performed by Halliburton at Virden, Manitoba, in 1951. This new process later became responsible for the development of Pembina as a commercial oilfield. Acquisitions of Welex and Imco, and entry into Industrial Services, broadened the base of company business. Halliburton's "total bulk" system is now revolutionizing the supply methods of barite and cement for the Beaufort Sea.



Halliburton was there when disaster struck, too. From mammoth grouting jobs requiring 30,000 sacks of cement to stop underground water flows in the potash mines of Saskatchewan to killing the world's most northerly blowout in the Arctic Islands during winter darkness; ingenuity and service have always been on call.

The name has been changed from Halliburton Oil Well Cementing to Halliburton Services Ltd. to reflect the wider range of company activity. But the objectives remain the same as they were in 1929 when the Halliburtons arrived in Alberta. Wherever Canada's search for oil and gas takes the country's intrepid explorers, be it ice platform wells near the top of the world or drilling vessels off Newfoundland's coast, you will find dedicated people from Halliburton. Forty-seven of them have over twenty years of company service. All of them, Canadians, working for a secure Canadian future of self reliance in energy.

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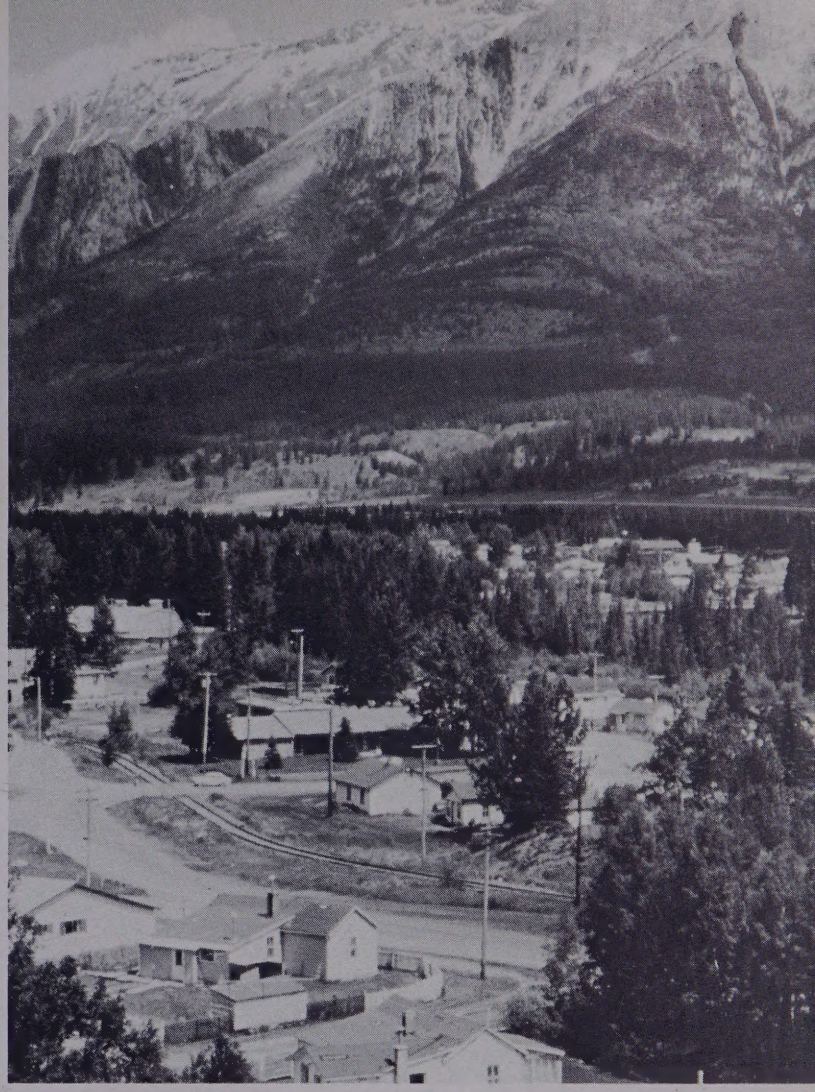
AUTHOR

A MARS TURBINE IS SAVING ENOUGH ENERGY TO KEEP CANMORE WARM ALL WINTER LONG.

(And another growing town just like it.)

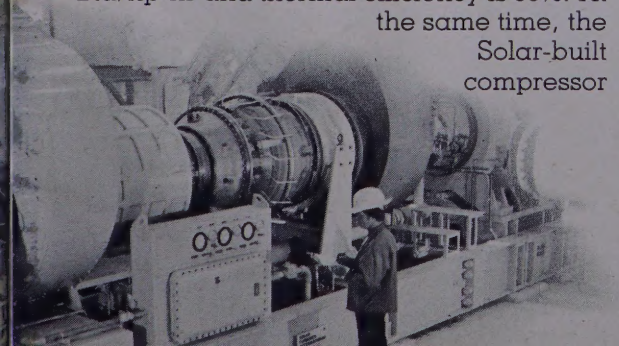


Canmore, Alberta, is on the edge of the Rocky Mountains just west of Calgary. Some 100 miles to the northwest at Nordegg compressor station the first of our new *Mars*® turbine packages is now at work.

The new 10,600 hp *Mars* turbine compressor set is so efficient it could keep all the homes in Canmore supplied with natural gas year-round with the energy it saves. And have enough left over for another town about the same size. No matter how low the temperature gets.

That's why Alberta Gas Trunk Line bought the *Mars* turbine package. The efficiency of the engine and the compressor together can save AGTL up to 650 million cubic feet of natural gas a year.

The new package is saving all this energy because its fuel consumption has been confirmed in the test cell at an unprecedented 7700 Btu/hp-hr and thermal efficiency is 33%. At the same time, the Solar-built compressor boasts 2% better efficiency than any centrifugal of its size available.



But saving energy is only part of the story. *Mars* turbine packages are a fraction of the size and weight of piston-engine units. The turbine is designed to run 30,000 hours before a major inspection. And the package is rugged and reliable.

More reasons why the *Mars* turbine set is perfect for the Nordegg job.

Take a cold look at your total system energy costs. Then write Solar Turbines Canada, International Harvester Company of Canada, Limited, P.O. Box 9087, Dept. B-200, Calgary, Alberta, T2P 2W4. We'll send you some information on a new turbine that will warm your heart.

SOLAR TURBINES CANADA

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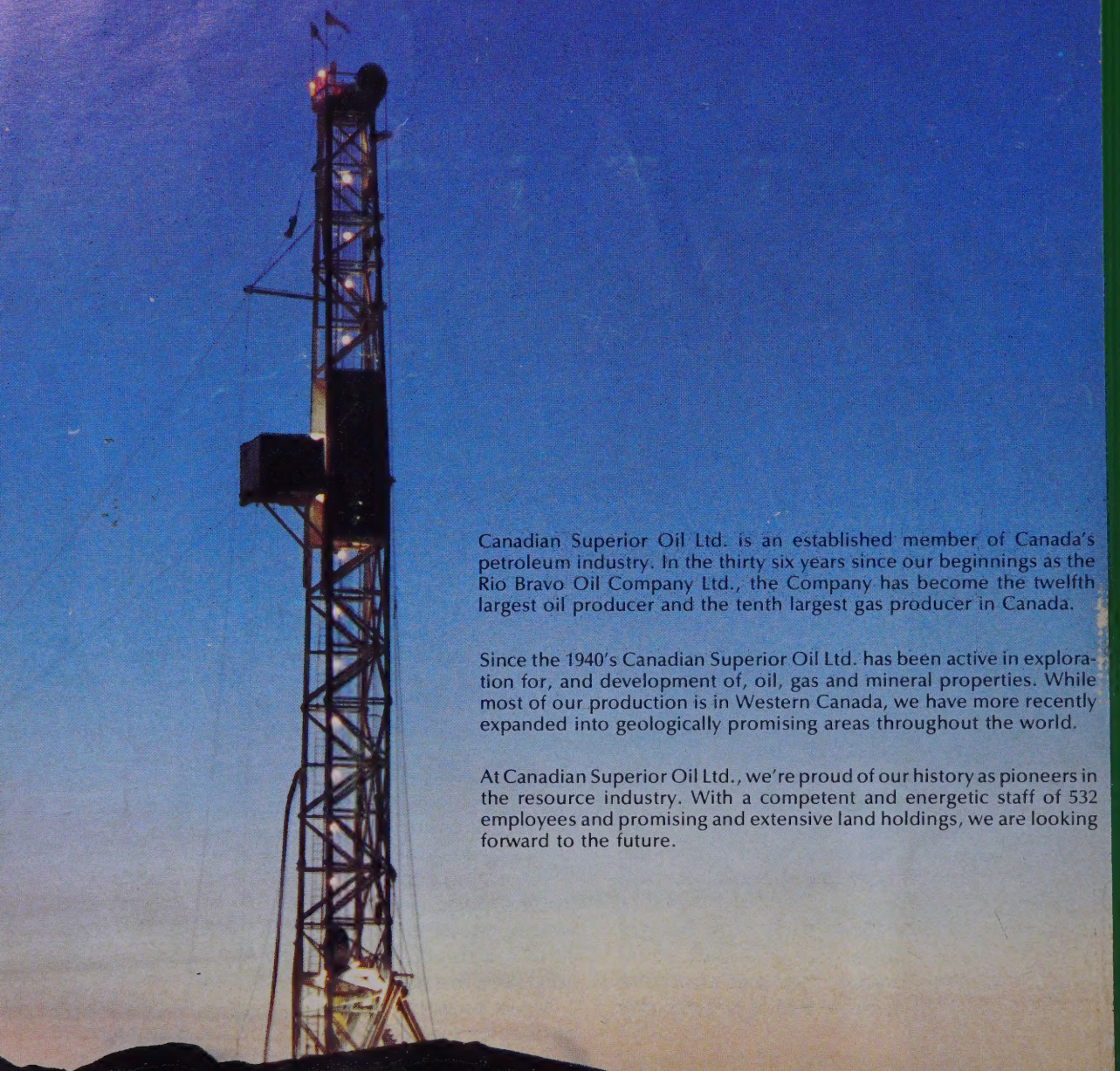

Canadian Superior Oil Ltd. is an established member of Canada's petroleum industry. In the thirty six years since our beginnings as the Rio Bravo Oil Company Ltd., the Company has become the twelfth largest oil producer and the tenth largest gas producer in Canada.

Since the 1940's Canadian Superior Oil Ltd. has been active in exploration for, and development of, oil, gas and mineral properties. While most of our production is in Western Canada, we have more recently expanded into geologically promising areas throughout the world.

At Canadian Superior Oil Ltd., we're proud of our history as pioneers in the resource industry. With a competent and energetic staff of 532 employees and promising and extensive land holdings, we are looking forward to the future.

CS

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